Grind perfect edges without burning, p. 62

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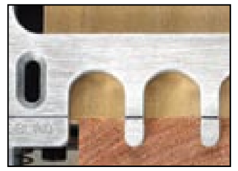
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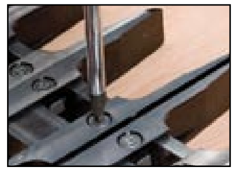
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Router bit depth gauges

Router stabilizer bar

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Fine WoodWorking

50 BETTER JIGS

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Back Cover
Scaling the heights

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VIDEOS

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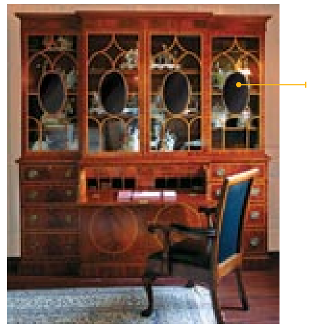
It's All in the Details

Learn more about how contributing editor Steve Latta ("Tool Test: Marking Knives") put a collection of these marking tools to a real-world woodworking test.



SLIDE SHOW

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See almost all of the 90 period pieces that the Irion Company ("Greatest Commission Ever?") chose and reproduced for one wealthy patron. Plus, go behind the scenes at this world-class workshop.

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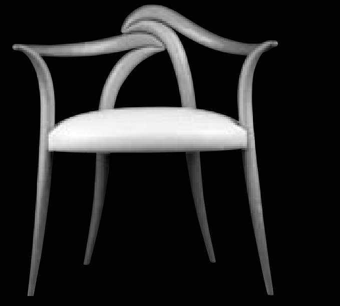

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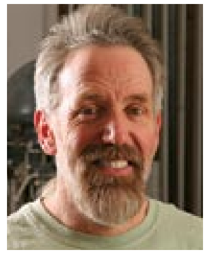
contributors

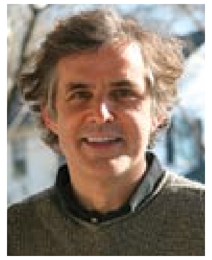
Russell Jensen (*"Japanese Garden Bench"*) opted into a local cabinetmaking course in Sudbury, Ontario, when the carpentry program he really wanted was full. Turns out it was for the best. Woodworking is his calling. As Jensen says, he would have been "the most precise framer in the world." When he started Jensen Fine Furniture in 1997, he was most interested in period-style reproductions, but has since moved to a Craftsman style. *Fine Woodworking* supplied the materials for the bench (pp. 38-45), and Jensen donated it to a local cancer center in memory of his father, Robert K. Jensen.



After a nine-year absence from *FWW*, **Peter Turner** (*"Add a Shelf to a Table"*) returns with innovative techniques for making a table more functional. Turner, who lives in South Portland, Maine, creates one-of-a-kind furniture with a clear Shaker lineage. He teaches a few weeks each year at The Center for Furniture Craftsmanship in Rockport, but mostly he sticks close to home, working in a shop behind his house. "I love what I make; I love what I do," he says, "and best of all, I can do it 10 steps from home." For more, go to www.petersturner.com.

Thanks to his television show "Wood Works" on the DIY network, **David Marks** (*Master Class*) is recognized around the world. He began building furniture in 1981 out of his Santa Rosa, Calif., studio, but in the 1990s shifted his focus to wood turning and sculpture. Among his many achievements are two NICHE Awards in 2001 for excellence in his craft. Besides teaching classes, he has produced two DVDs: "Gilding & Chemical Patinations" and "Jigs & Fixtures for Curvilinear Woodworking." For more, visit www.djmarks.com.

A lifelong interest in traditional tools and techniques led **Joel Moskowitz** (*"Grind Perfect Edges Without Burning"*) to open the retail catalog business Tools for Working Wood. Recently, he started his own line of hand tools under the Gramercy Tools brand. Moskowitz studied with Maurice Fraser (an early *FWW* contributor) in the 1980s, and popularized Fraser's sharpening methods in a series of DVDs.



A former senior editor at *FWW*, **Jonathan Binzen** (*"Greatest Commission Ever?"*) is probably best known to readers for finding outstanding woodworkers and writing about their pieces on the back cover. In the 1980s, he taught woodworking at a school for refugees in Philadelphia and later spent several years in Malaysia writing, working in a refugee camp, and making furniture. He now lives in New Milford, Conn., caring for his daughters and writing about furniture and interiors.

For more information on our contributors, go to FineWoodworking.com/authors.

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letters

Spotlight

DOES ADVERTISING INFLUENCE TOOL REVIEWS?

I recently was given several issues of *Fine Woodworking*, and I was very impressed with the content. In six magazines, I found answers to eight of my most troublesome questions. My problem is that I have trouble believing in publishers' integrity these days. Before I subscribe, I'd like you to answer the following questions: When you do product comparisons, how do you pick the ones you are going to test? Do you contact these companies prior to beginning the investigation? Do you ask them for anything in exchange for including their products in the comparison? Do you ask them for a unit to sample? Are you biased toward the companies that advertise in your magazine?

—RANDOLPH TORRES, Pittsburg, Calif.

Editor replies: One of the reasons editors enjoy working at The Taunton Press is that these critical questions have simple answers here. Journalistic integrity is at the core of our business model, and readers rely on us to give them the unvarnished truth. So we maintain a buffer between advertising and editorial. As a result you will find no correlation between ad dollars and the winners of our tool tests. When advertisers buy space in the magazine, they are buying access to our audience, which is the most passionate and committed available. They understand that they are not buying favorable editorial coverage.

When we assemble a list of tools for a head-to-head review, we use factors like power, capacity, availability, and price to choose a group that a typical reader would be considering (we survey our readers often to keep track of their changing needs and habits).

For small tools, where we can afford to buy all of the test samples, we generally do not contact manufacturers. But for larger tools we do. Manufacturers send us machines and tools off the production line in those cases. We promise them nothing in return, not even a guarantee of being included in the article, and we return the tools when we're done.

I hope this allays your concerns. As a journalist, I appreciate a healthy dose of skepticism.

—Asa Christiana

The sun also rises

The "Passive solar shop" article (Shop Design, *FWW* #195) oversimplifies the process of determining sun angles. During the summer months, windows need to be fully shaded from about 10 a.m. to about 3 p.m. If the windows are fully shaded only at noon (as the photo and drawing show) then in the late morning and afternoon there will be a large amount of glass exposed to sun.

If you are lucky enough to have a year to plan before you build, the story-pole method shown in the article will work, but in June you should take note of the angles from 10 a.m. to 3 p.m.

—JOHN L. SCHACKAI, New Orleans, La.

An easier kitchen than Norm's

While I enjoyed reading "My Dream Kitchen" by Norm Abram (*FWW* #196), I found some of his suggestions to be problematic. As a master carpenter with 30 years of experience and as a professional estimator, I am acutely aware of techniques that can either make a project efficient and quick or labor intensive and cumbersome. Here are some suggestions to make the process a lot easier for your readers.

1. Build full-overlay cabinets. They have a sleek "European" look and are easy to calculate. They also eliminate the need for face frames. 2. Construct your carcases with simple butt joints held together with good steel screws (go ahead and try to break them apart). 3. Use detached

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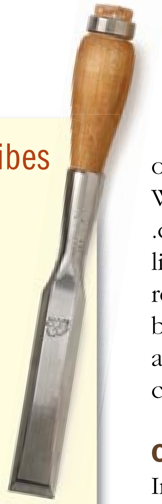
Fine Woodworking needs an editor with a passion for woodworking. You'll be based in our Connecticut headquarters, but you'll travel monthly to visit talented furniture makers around the country. Applicants must be active woodworkers with significant writing or editing experience. We offer a competitive salary, excellent benefits, and a great working environment. Apply at http://careers.taunton.com.

bases so you can install them ahead of the carcases. Shim them level and lock them down. You work out all the bugs with lightweight, easy-to-handle parts rather than big, bulky cabinet boxes. 4. Install your uppers first so you don't have to climb over your base cabs. 5. If at all possible, try not to scribe whole cabinets. Use detachable scribe strips or panels so you don't have to continually reinstall the whole cabinet to test the fit. 6. I recommend against painted cabinets. Spring for some nice veneer plywood for the doors and drawers (about $130/sheet) and finish them with a brush-on product that you can apply in your garage. Unless you are using an opaque, sprayed conversion varnish, your paint job will not be durable or pretty.

—LAWRENCE MOTTA, San Francisco

YOUR TAKE



Which phrase best describes your use of hand tools?

2%	They're all I use
18%	For everything but dimensioning lumber
24%	To prep surfaces and trim joints
41%	I use chisels a lot, handsaws and planes only occasionally
13%	I hardly ever use hand tools
2%	Other

In our e-Letter, we poll readers on new questions each month. Sign up for the free newsletter at FineWoodworking.com.

Square crosscuts on the tablesaw

In "Are you getting the most from your combo square?" (Fundamentals, *FWW* #197), the author is off base when he says that "a miter gauge won't deliver square crosscuts if its fence is not 90° to the blade." In order for a miter gauge to provide square crosscuts, its fence must be 90° to its line of travel (miter slot). Blade alignment will affect cut quality, but it should not affect the squareness of the cut. If you rely on the blade when squaring up the miter gauge, and the blade is out of alignment with the miter slot, the cut will be out of alignment as well.

—PHIL GAUDIO, West Simsbury, Conn.

Wood planes really are easy

Your article "Wood Planes Made Easy" (*FWW* #196) finally tipped me into action to build some planes. I have wanted to try them since first reading an article by Ejler Hjorth-Westh in the June 1995 issue of *Woodwork* magazine. I built a large hard maple table last year and struggled mightily with smoothing the top. My jack planes and smoothing planes resulted in too much tearout. And my scraper was ineffective on such a scale. I finished the table, but when I read your recent article, it was time for action.

I made two high-angle planes, 60° and 75°, intended for use on figured woods. Your article made it easy to complete the first plane, and the second was even easier. I found that using the chopsaw was very safe and accurate for cutting the blade ramp. No follow-up truing was required. I made my planes from maple with an ipé sole, since I found both in my scrap pile. They cut very nicely, though I still need some practice in setting the irons.

—STANLEY BACKLUND, Camino, Calif.

Editor replies: *For tips from the author on setting the blade and using the plane, go to FineWoodworking.com/extras and scroll down to issue #196 for a free video.*

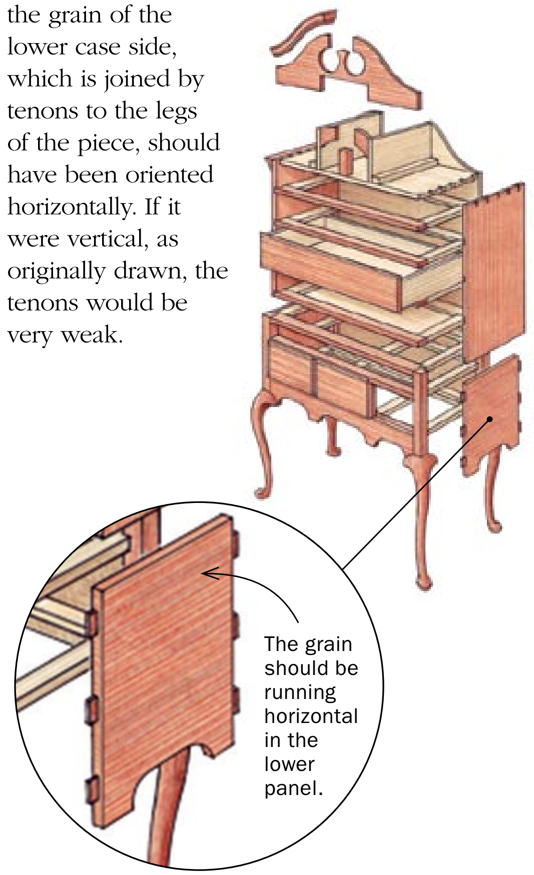
Clarification

To buy the carbide cutters that can be screwed to a shopmade wood handle and used as a durable scraper (Methods of Work, *FWW* #197, p. 16), go to Woodworker's Supply (www.woodworker.com), not Carbide Depot as we originally listed. Look for cutters intended as replacement knives for Freud flush-trim bits (catalog Nos. CG12 and CG13); you also can use four-sided inserts for a jointer cutterhead (115-001).

Corrections

In the article "New Twist on a Sleigh Bed" (*FWW* #197), the dowels connecting the top rails to the legs should be ½ in. dia. and not ⅜ in. as shown, while those connecting the X-slats to the rails should be ⅜ in. dia. and extend ½ in. into the slats and the rails. The distance from the base of the footboard leg to the bottom of the lower cross-rail mortise should be 13¼ in. and not 14¼ in.

In the drawing of a highboy in "Buying lumber a bit at a time" (Q&A, *FWW* #196), the grain of the lower case side, which is joined by tenons to the legs of the piece, should have been oriented horizontally. If it were vertical, as originally drawn, the tenons would be very weak.



About your safety

Working wood is inherently dangerous. Using hand or power tools improperly or ignoring standard safety practices can lead to permanent injury or even death. Don't perform operations you learn about here (or elsewhere) until you're certain they are safe for you. If something about an operation doesn't feel right, find another way. We want you to enjoy the craft, so please keep safety foremost in your mind.

Drawings: Vince Babak

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EDITED AND DRAWN BY JIM RICHEY

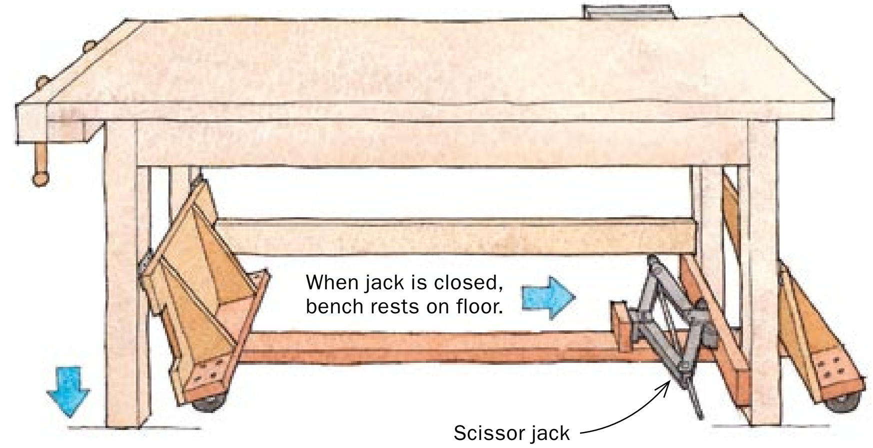
Rolling lift for a workbench

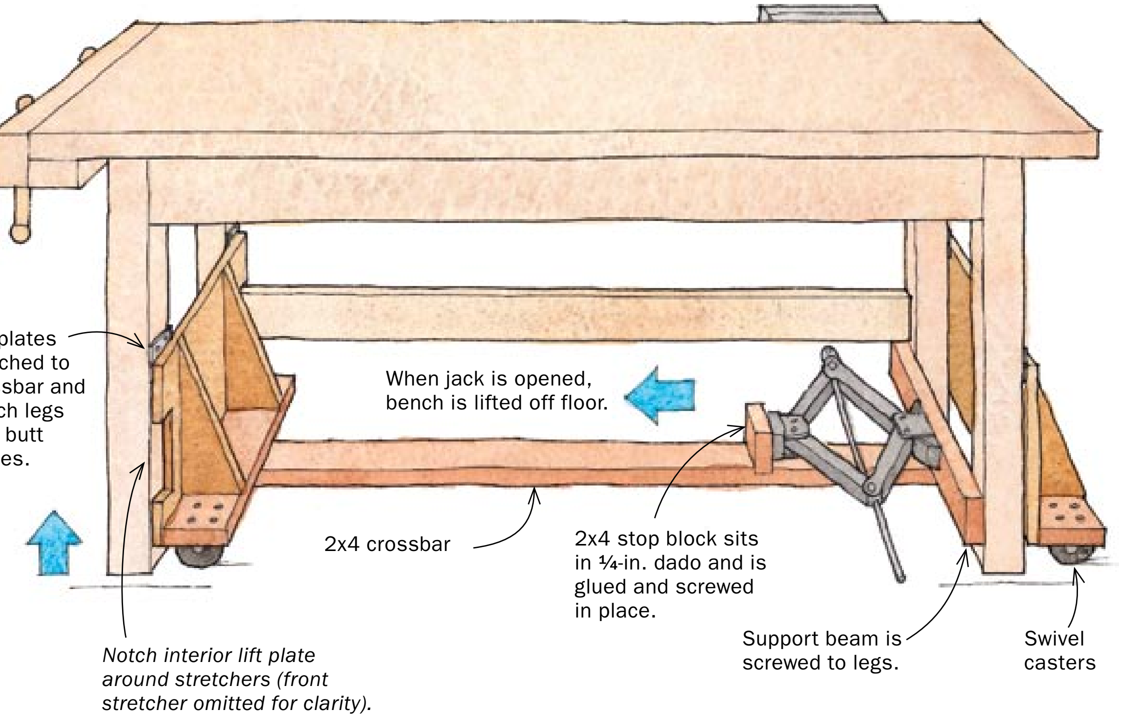
When I built my workbench, I didn't skimp on materials. As a result, the bench weighs around 300 lb. Because my shop is small, I occasionally need to move the beast—not an easy task for one person.

To make life easier, I came up with this design for a rolling lift, which uses wood scraps, a small car jack (picked up for $10 at the scrap yard), four heavy-duty swivel casters, and six butt hinges.

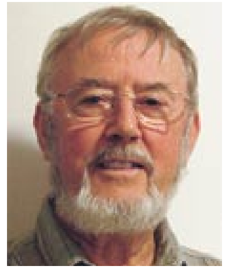
The mechanism consists of two lift plates made from plywood and 2x6s, attached to the bench legs with hinges. Two casters are secured to the base of each lift plate. A 2x4 crossbar, attached to the lift plates with hinges, lifts the bench onto the casters when the car jack is opened. Closing the jack drops the bench onto its own legs. The mechanism is simple but effective.

—TIM JANSSEN, Toronto, Ont., Canada





Best Tip



Since retiring in 2000, Tim Janssen has devoted much of his spare time to woodworking, "with some of it actually resulting in finished projects," he says. In the process of expanding his 8-ft. by 16-ft. basement shop, Janssen expects to rack up more miles on his rolling bench.

A Reward for the Best Tip

Send original tips to Methods of Work, *Fine Woodworking*, PO Box 5506, Newtown, CT 06470, or email fwmow@taunton.com. If published, we pay $50 for an unillustrated tip; $100 for an illustrated one. The author of the best tip gets a Leigh 18-in. Superjig, with the vacuum/router-support accessory.

READER SERVICE NO. 88

READER SERVICE NO. 2

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Inexpensive substitute for a sharpening sink

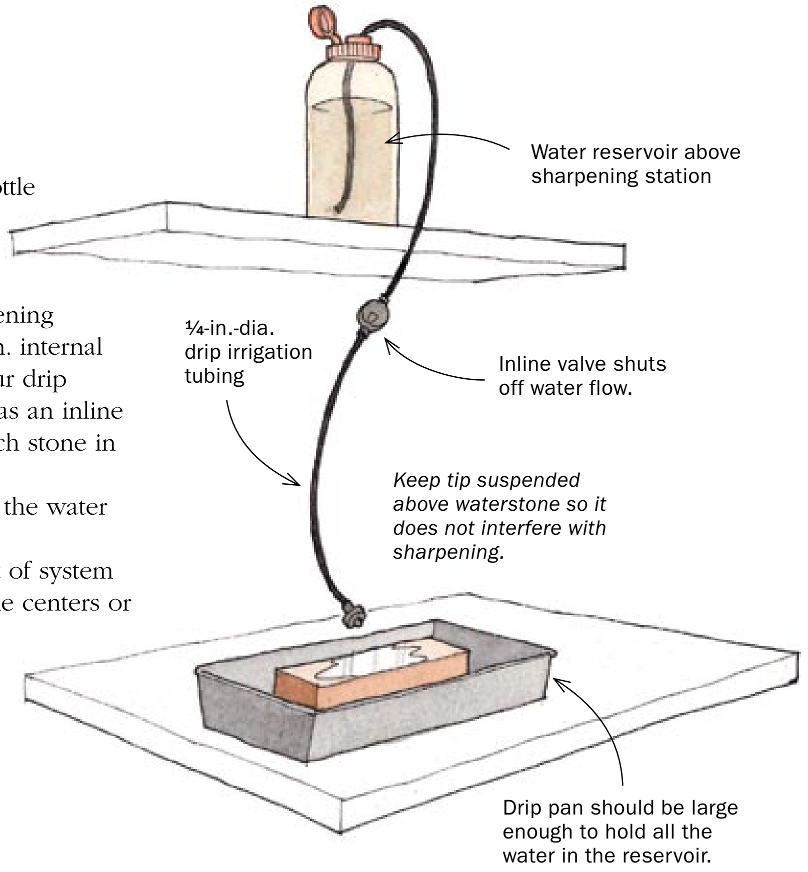
Because I don't have a sink in my shop, I used to use a squirt bottle to wet my waterstones during sharpening, but that was tedious and interrupted the sharpening flow. Now I use a simple drip system pulled together from castoff hardware.

A Tupperware water jug is placed on a shelf above the sharpening station. The water is siphon-fed from the reservoir through ¼-in. internal diameter drip tubing. I have one 6-ft. hose with a 1-gal.-per-hour drip emitter and another with a 2-gal.-per-hour emitter; each hose has an inline valve. I select which hose to use based on how much water each stone in use needs.

To start the siphon initially, I sucked through the emitter until the water was flowing. To turn the flow on and off, I use the inline valve.

To avoid flooding the shop, I'd definitely not connect this sort of system to plumbing. Drip irrigation materials are available at most home centers or online at www.dripirrigation.com.

—DAVE STAGGERS, Tucson, Ariz.

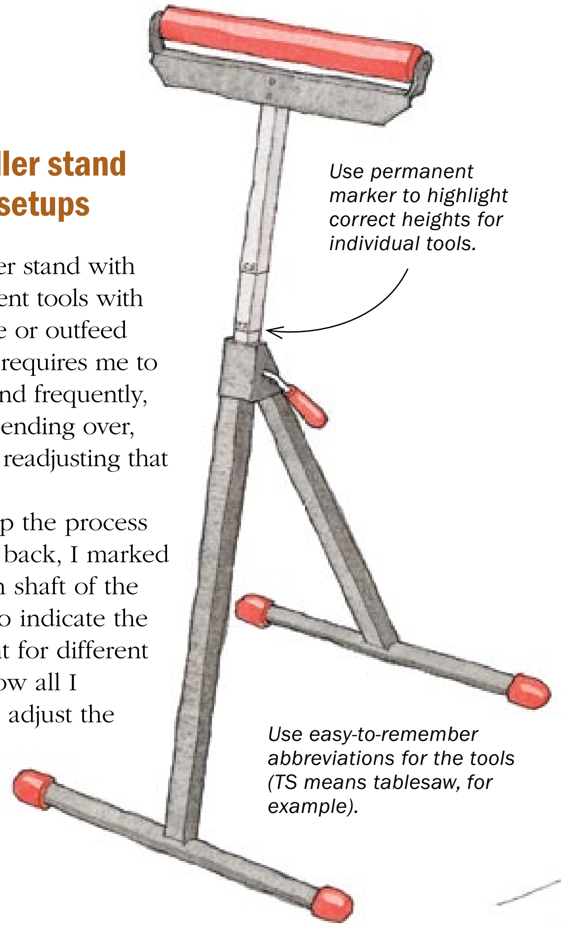


Mark a roller stand for faster setups

I use my roller stand with several different tools with different table or outfeed heights. This requires me to adjust the stand frequently, with all the bending over, sighting, and readjusting that involves.

To speed up the process and save my back, I marked the extension shaft of the roller stand to indicate the correct height for different machines. Now all I have to do is adjust the extension to the right line, tighten the handle, and go to work.

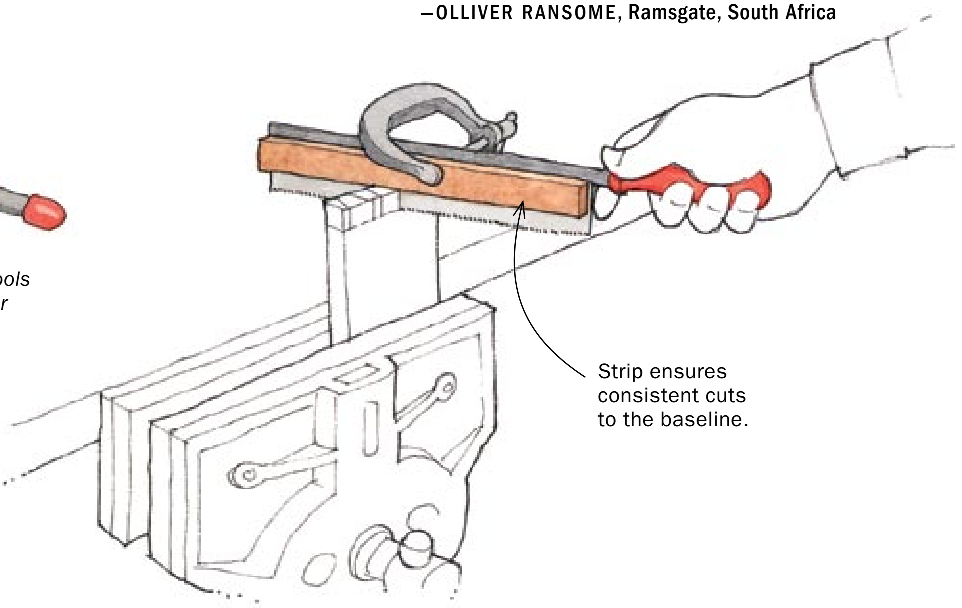
—JOEL HARRELL, Raleigh, N.C.



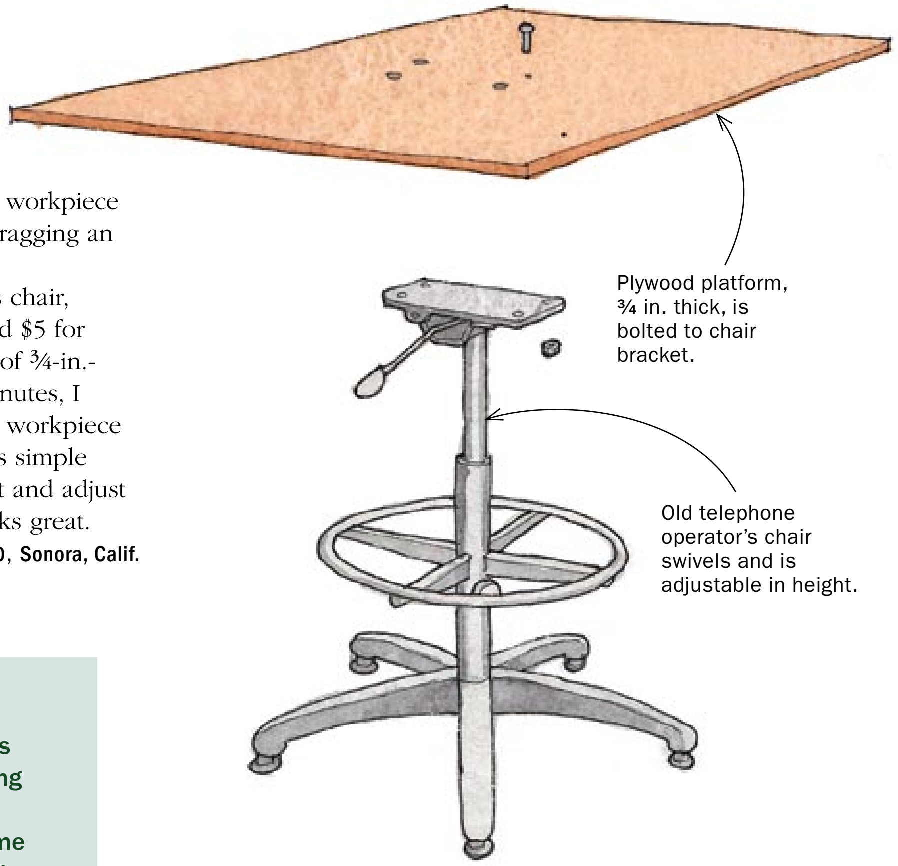
Depth stop for a dovetail saw

I found it difficult to saw exactly to the baseline consistently when making dovetail pins and tails. But this extremely simple jig guarantees absolute accuracy. It consists of a thin strip of wood, the width of which is determined by subtracting the depth of the dovetail from the width of the backsaw blade. Clamp the strip to the saw so that it is parallel to the sawteeth, and cut away until the strip bottoms out on the edge of the board. The result will be perfect stops at the baseline from front to back.

—OLLIVER RANSOME, Ramsgate, South Africa



Oversize lazy susan helps with finishing



In the past, when brushing or spraying pieces, I often managed to mar the finish by leaving fingerprints on the workpiece as I tried to maneuver it for access, or by inadvertently dragging an air hose across it.

At a flea market, I bought an old telephone operator's chair, the kind that swivels and adjusts up and down. I offered $5 for it, took it home, removed the chair, and bolted a piece of ¾-in.-thick plywood to the chair bracket. Bingo! In just 10 minutes, I had a large lazy susan that gives me access to an entire workpiece without having to touch areas I've already finished. This simple device allows me to turn the workpiece any way I want and adjust the height to any level. It isn't beautiful, but it sure works great.

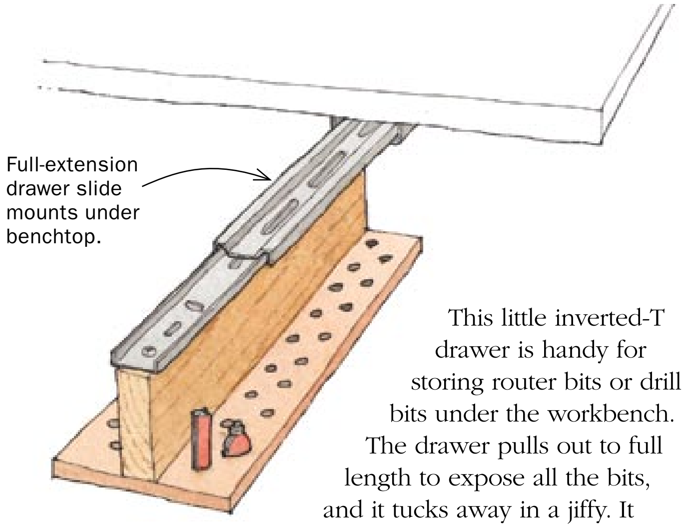
—ERNEST M. CUZZOCREO, Sonora, Calif.

Quick Tip

When adjusting a bandsaw or changing its blade, it is difficult to set up the lower blade guides when peering under the table, especially for those of us who wear bifocals. That's why I remove the table, which gives me unobstructed access to both the guides. Just remember to square the table to the blade once you put it back on.

—RON LATTNER, Banks, Ore.

T-drawer keeps router bits organized



This little inverted-T drawer is handy for storing router bits or drill bits under the workbench. The drawer pulls out to full length to expose all the bits, and it tucks away in a jiffy. It uses only two pieces of wood: the vertical member is screwed to the lower horizontal member, which holds the bits. Mount the drawer to the underside of the benchtop with a full-extension ball-bearing drawer slide.

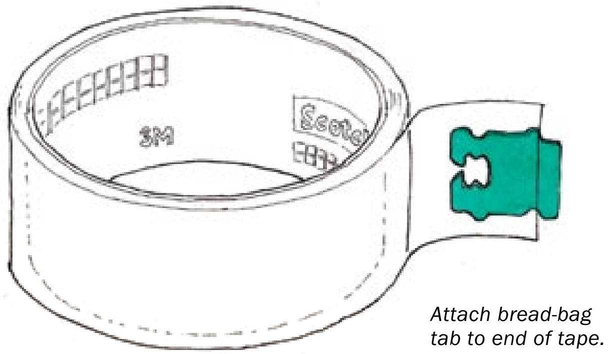
—BRIAN GEERTS, Brantford, Ont., Canada

Quick way to find the end of the tape

If, like me, you have fought with a roll of clear packing tape trying to find the end, here is a simple solution. Stick a plastic bag tab, the kind used to close the bag on a loaf of bread, under the end of the tape.

Now when you need some tape, just grab the tab and pull off what you need from the roll. Cut the tape to length, then stick the tab back on the end of the roll. Press down firmly on the tape to lock the bag tab in place. Everything is set for the next time.

—DAVID J. VALOVICH, Fairfield, Conn.



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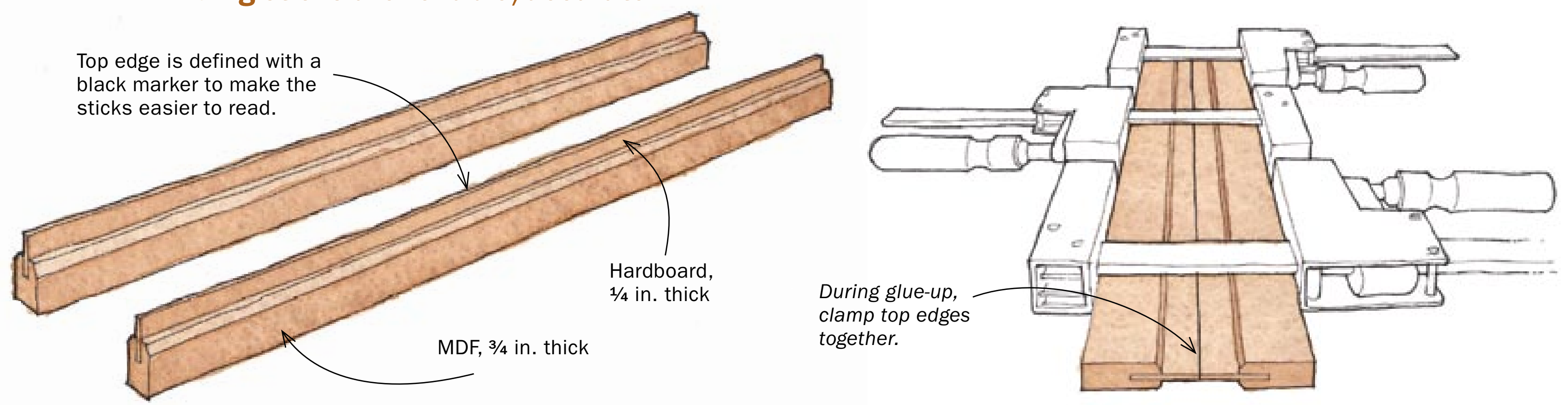
READER SERVICE NO. 92

MDF winding sticks are reliable, accurate



Winding sticks are invaluable for helping to check the flatness of large boards, but they become useless if they warp as humidity levels change. So I avoided that problem by making a pair of winding sticks out of MDF and hardboard. These sticks will remain accurate despite varying humidity conditions.

The MDF strips, ¾ in. thick by 1½ in. wide by 2 ft. long, have ¾-in.-deep grooves to fit the ¼-in.-thick by 1½-in.-wide hardboard strips. Before gluing up the winding sticks, I chamfered the top edges of the MDF supports. The chamfers will help deflect any bumps or dings and make handling the sticks more comfortable.

The hardboard strips are glued in the grooves. To make sure the sticks remain parallel to each other, I clamped them top edge to top edge, as shown above.

Finally, I lightly sanded all sharp edges and, using a permanent black marker, drew a fine line along the corner of the top edge of each hardboard strip to make it easier to read the sticks when at work.

—SERGE DUCLOS, Delson, Que., Canada

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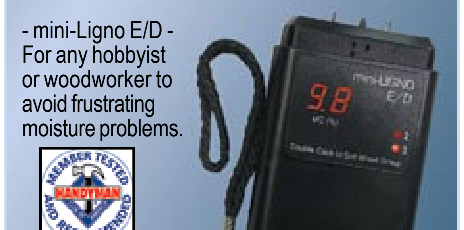

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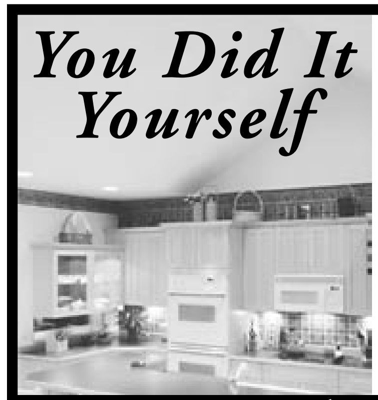

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tools & materials

Cambered wheel yields cambered edge. *Veritas now offers a cambered roller for its Mk.II honing guide. It lets you hone a slight curve on a plane blade, so the corners are less likely to dig in and leave ridges on the wood surface.*

FINISHING

Compact, low-cost spray system works well

Editor's note: *As part of the article "Spray-Gun Choices," in* FWW *#194, we used the Earlex Spray Station Pro System with the supplied 2-mm tip and needle. In the article, the author had trouble spraying water-based finish with the Earlex. That prompted a response from Earlex—which ran as a letter in* FWW *#196—saying that a 2-mm tip wasn't suitable, and that a 1-mm or 1.5-mm tip would produce a high-quality finish. With that in mind, we asked another finishing expert to test the unit, using a variety of tips.*

I HAD NO TROUBLE SPRAYING WATER-BASED FINISH right from the can, with no thinner added. The fluid flow was ideal and the material atomization was sufficient to allow the finish to flow out into a smooth coating without any orange peel or mottling. I ran the same finish through 1-mm, 1.5-mm, 2-mm, and 2.5-mm tips and, other than a relative increase or decrease in fluid flow, I could see no real differences in the quality of the finish.

That said, the water-based lacquer I used (Ultima Spray Lacquer; available at www.targetcoatings.com) is designed for production spraying, so the results with other off-the-shelf products might be different.

If you run a production shop and spray eight hours a day, this probably isn't the system for you. But for anyone spraying only occasionally or looking for an inexpensive alternative to brushes and rags, this system is a great value. The Earlex Spray Station sells for $325 at www.woodcraft.com.

—Andy Charron operates Charron Wood Products in Windsor, Vt.

Online Extra

To post ratings and reviews of the tools you own and to browse our free archive of tool reviews from the last five years of *Fine Woodworking* magazine, go to **FineWoodworking.com/ToolGuide.**

SHARPENING

Jig accessory produces smoother cuts

WHEN VERITAS INTRODUCED the Mk.II, I felt they had the perfect honing guide. After using it for a while, though, I realized it might be a little too perfect.

The wide roller on the Veritas guide ensures a flat bevel on the blade. That's fine for bench chisels, but on wide blades used for planing, I prefer a bevel with a slight curve (or camber) from one edge to the other. A camber helps reduce plane tracks—the scoring lines often created by the blade corners as you plane.

When honing without a guide, or when using a guide with narrow wheels, I produce the camber by placing pressure on the outer edges of the blade. But because of the wide roller on the Mk.II, I couldn't get the same cambered results.

Someone at Veritas must have read my mind because they recently introduced a cambered roller assembly for the Mk.II. The assembly mounts in seconds. A ½-in.-wide flat center section of the roller provides solid footing for flat bevels, while the outer sections are curved for easy blade cambering. It worked great.

The cambered roller sells for $21.70 at www.leevalley.com.

—Michael Pekovich is the art director.

Rock on. *As you move the jig back and forth on the sharpening stone, the cambered wheel allows you to rock the blade from side to side, in a controlled manner, to generate the curved edge.*

Shaving tells the tale. *When properly cambered, the plane iron produces a shaving that is thicker in the middle and feathery at the edges.*

Photos: Staff

HAND TOOLS

Know what a float is?

LIE-NIELSEN RECENTLY INTRODUCED two styles of floats: joinery and plane-making. Joinery floats are made for fitting joints; plane-making floats are designed for making wood planes.

Floats are essentially single-cut files with coarse teeth. As you might expect, the coarse teeth remove material quickly, much like a rasp. But unlike rasps, floats produce a surprisingly smooth surface.

Both float styles come in several shapes and sizes and you can choose either a push or pull design. All have 8 teeth per inch, with 80° rake angles, and are fitted with comfortable maple handles.

They come from the factory sharp enough to use, but I found they worked even better after filing each tooth with a triangular saw file. The filing process is easy, and depending on the size and shape of the float, takes between 15 minutes and 45 minutes.

Lie-Nielsen makes its floats from S-7 steel, hardened and tempered to a Rockwell hardness of 50–52. As a result, the floats hold a keen edge.

I put the joinery floats to work on a range of joints. They removed wood quickly, leaving a pile of fine shavings rather than dust. What's more, they left a smooth finish in their wake.

Floats aren't likely to replace my chisels or shoulder planes, but I can see where having a few around will open up new possibilities when facing challenging joinery tasks.

The floats sell for $40 to $60. Go to www.lie-nielsen.com for a closer look.

—Chris Gochnour builds furniture and teaches woodworking in Murray, Utah.

Joinery floats. *These do a good job trimming tenons and squaring the ends of mortises (below). Note that the top float (above) has been sharpened.*

Plane floats. *An edge float is ideal for widening the mouth of a wooden plane.*

Customized saw. *Thanks to an Ohio company, you can now buy a Powermatic 2000 tablesaw in your favorite color. You can also ask for a Baldor motor and either colored or wood knobs.*

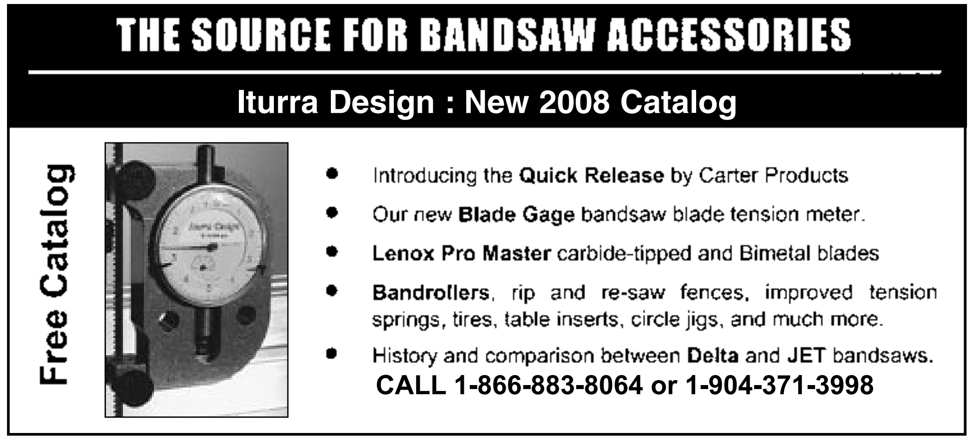
MACHINES

Tricked-out Powermatic

IF YOU'RE SOMEONE WHO PREFERS to order à la carte at a restaurant, you just might want to talk to the people at Woodwerks Supply of Columbus, Ohio. They are now offering made-to-order Powermatic 2000 tablesaws.

Options include American-made Baldor motors, a Blanchard-ground top (a throwback to the classic PM 66 model), custom knobs, a personalized nameplate, and about any color that suits your fancy. If a pretty-in-pink or fire-engine-red saw has long been your dream, check out the menu and prices at www.woodwerks.com.

—Tom Begnal is an associate editor.



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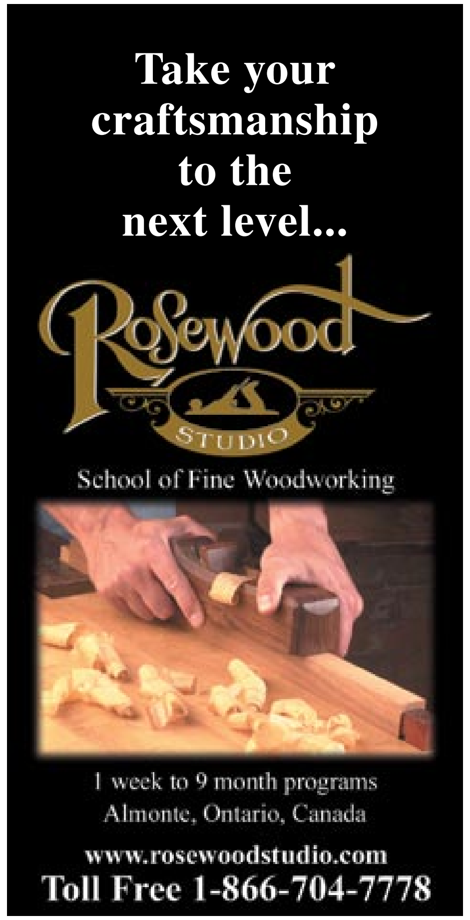

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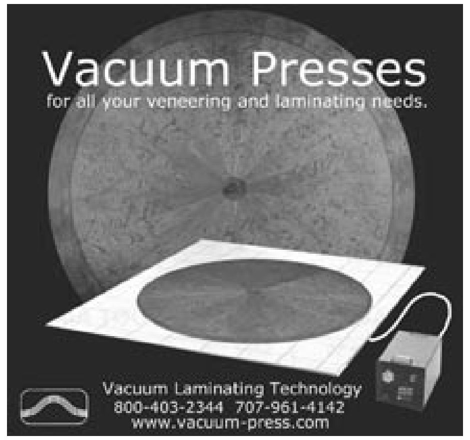

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ACCESSORIES

Clamp gets holding force from compressed air

Small parts accepted. *Adding extra strips of seal material allows you to clamp parts that only partially cover the V-Clamp.*

FOR SAFETY'S SAKE, WHEN ROUTING OR SANDING, it's important to keep the workpiece clamped securely to the workbench. But clamps often get in the way of such work. When they do, you have to spend extra time repositioning them as you rout or sand your way around the workpiece. Now there's a gadget from Australia that lets you work clamp-free, and the clamping process is almost instantaneous.

The product, called the V-Clamp, uses your air compressor to create a vacuum. It comes in two models. The VC5 uses the vacuum feature to hold the V-Clamp to the workbench and the workpiece to the V-Clamp. The less-expensive VC4 mounts to the workbench with four screws, and the vacuum is used only to secure the workpiece to the V-Clamp.

According to the manufacturer, both models generate about 330 lb. of holding force, or about 12½ lb. per square inch. Once set up, you just place the workpiece on the clamp and press down lightly to get a seal. When you want to remove the workpiece, just shut off the compressor. To make it more convenient to turn the vacuum on and off, V-clamp sells a lever-valve as an optional accessory.

The VC4 sells for $55; the VC5 for $65. More details can be found at www.vac-clamp.com.

—*T.B.*

Clamp-free clamp. *The V-Clamp measures just 6¼ in. square by 1⅛ in. thick. It uses compressed air to generate a vacuum that produces over 300 lb. of clamping force (model VC5 shown).*

FINISHING

A clearly green finish

Farm fresh? *Using whey as a binding agent, Vermont Natural Coatings produces water-based finishes that are far less yellow than oil-based finishes.*

IF SOMEONE MENTIONS VERMONT DAIRY PRODUCTS, you might think of Cabot cheese or Ben & Jerry's ice cream. Chances are you wouldn't think of a modern wood finish. That might change now that Vermont Natural Coatings has started using whey, a by-product of cheese making, as the bonding agent in two new water-based finishes: PolyWhey furniture finish and PolyWhey floor finish.

Both products have especially low levels of volatile organic compounds (VOCs). Indeed, they have no more than 180 grams per liter. That compares to 275 grams per liter for Minwax's water-based Polycrylic and around 750 grams per liter for shellac or solvent-based lacquer. In addition to being better for your lungs and the environment, these two finishes have almost no odor.

I first tried the gloss version of the furniture finish on a variety of woods. On the plus side, the finish went on easily when I used a fine-haired artist's brush. It took just three coats to get a good build. When used on maple, the wood maintained its naturally pale look. On the downside, using a foam brush left too many bubbles; when used with dark walnut the finish left an unpleasant purple/blue tint; and cherry and oak looked a bit lifeless.

I next used the floor finish on a flight of unfinished pine basement stairs. It went on easily with an artificial-bristle brush, didn't run on vertical surfaces, and sanded easily after less than two hours between coats. And, because I was working in a confined space, the low VOCs made life a lot easier. Go to www.vermontnaturalcoatings.com for more information.

—Mark Schofield is the managing editor.

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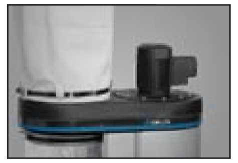

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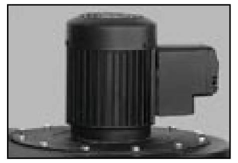

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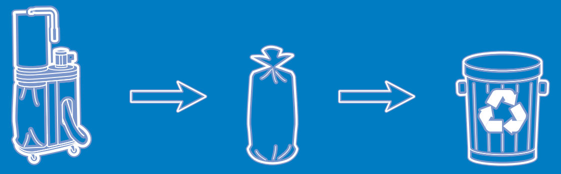

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Biscuit-joint basics

BY TOM BEGNAL

It will never match the beauty of a dovetail or the strength of a mortise-and-tenon, but for speed, accuracy, and ease of use, it's hard to beat the biscuit joint.

Biscuit joints can be used on all wood products: solid wood, plywood, medium-density fiberboard (MDF), and particleboard. For this reason, they are great for cabinetry, which typically involves a mix of solid wood and sheet goods. Biscuits are a great way to join a plywood carcase and attach an assembled face frame. They also help keep things aligned when gluing solid-wood edging to plywood or assembling solid boards into a wide panel.

Biscuit joiner cuts the slots

A dedicated tool and an oddly shaped tenon combine to create a biscuit joint. At the heart of the process is a power tool called a biscuit joiner or a plate joiner. To make a joint, use the tool to cut a shallow slot in each of the mating parts. Then, after adding glue to each slot, insert a thin, football-shaped biscuit into one slot. A little more than half the biscuit's width goes into the slot; the other half sticks out. To complete the joint, just slip the mating slot onto the "tenon" and clamp the parts together.

The biscuit joiner has just four main parts: a motor, a blade that cuts the slot, an adjustable fence that aligns some types of cut, and a base that houses the blade and also can align cuts.

The 4-in.-dia. blade looks like a miniature tablesaw blade. Unlike a tablesaw blade, however, the biscuit-joiner blade cuts horizontally. The kerf it creates, commonly called the slot, measures about ⅛ in., just wide enough to accept standard-thickness biscuits.

Thanks to a spring-loaded sliding "way" that connects the base and motor, you can butt the front of the base against a workpiece, start the motor, and push it forward. The spinning blade emerges from the front of the tool to cut a shallow arc-shaped slot in the workpiece. Release the forward pressure, and the springs push the motor back to retract the spinning blade safely into the base.

Expanding biscuits fill the slots

The second element in this joint is the biscuit. Made from beechwood or white birch that has been thoroughly dried, biscuits are compressed by machine to a standard thickness. For maximum all-around strength, the biscuits are cut so the grain runs diagonally.

When a biscuit comes into contact with moisture, it swells. So when you insert a biscuit into a glue-lined slot, the biscuit expands, creating a snug fit and a tight joint. It is important to use only water-based glues such as common yellow PVA glue. Biscuits won't work with epoxy, cyanoacrylate ("super") glue, or polyurethane glues.

Biscuits come in three standard sizes, No. 0, No. 10, and No. 20. The biscuit joiner has preset depth stops that match these sizes.

Use the fence or the base to locate the slot

When using a biscuit joiner, you have two ways—the fence or the base—to register the slot in the workpiece. Each has advantages.

For extra flexibility, the adjustable fence lets you position the slot anywhere between 3/16 in. and 1 in. from the fence (if the biscuit is any closer than 3/16 in. to the surface of the workpiece, its swelling could create a bulge on the surface). Also, you can set the fence to cut slots in angled joints.

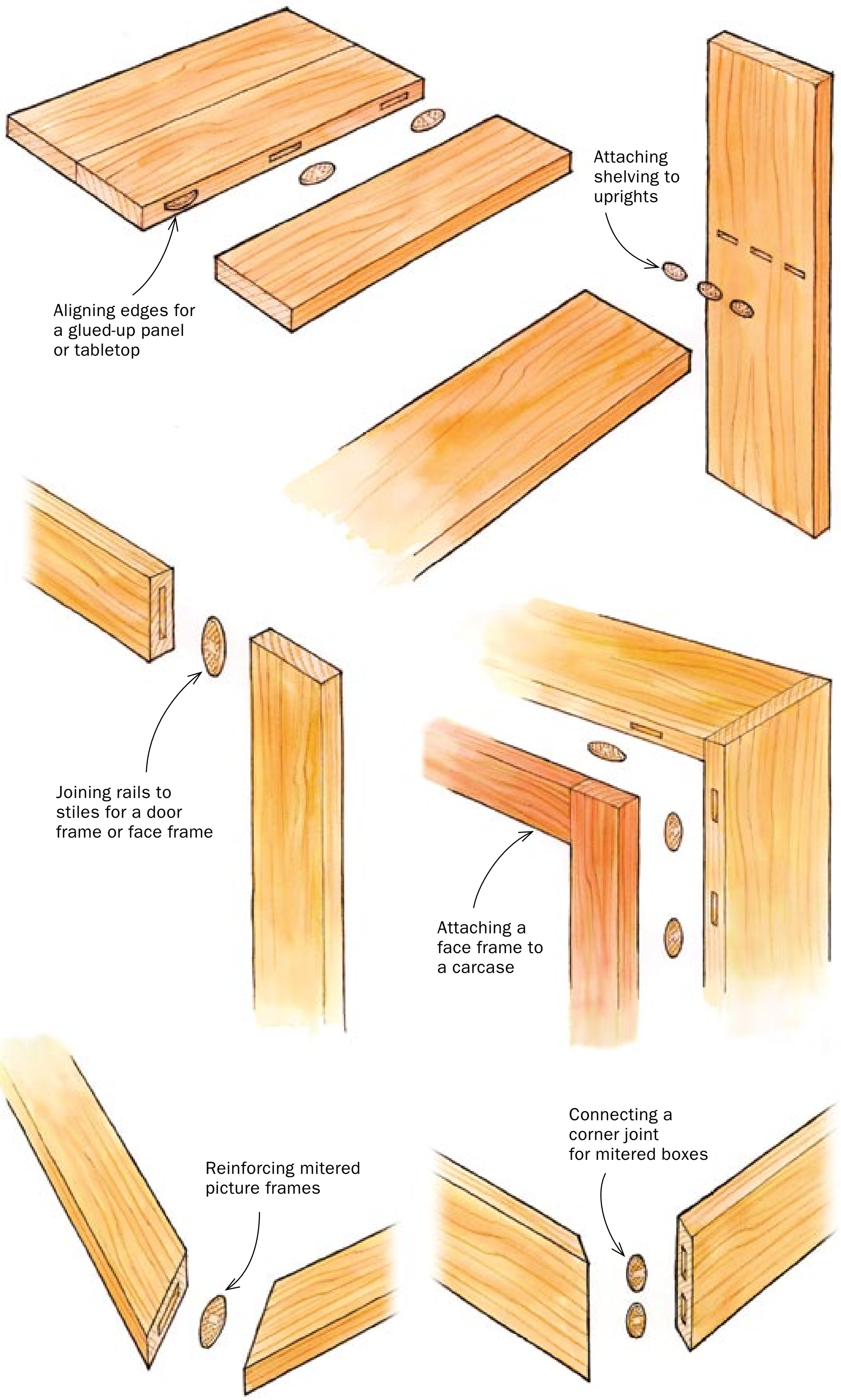
However, if all you want to do is center a slot on ¾-in.-thick stock, it's easier to register off the base. This is because the center of the kerf is located ⅜ in. from the bottom of the base. To create a slot in ¾-in.-thick stock, place the base and the stock on the same flat surface and make the cut. It's OK if the slot isn't exactly centered; just

All about biscuits

Simple and efficient. *An adjustable stop on the joiner (left) controls the depth of cut to match each of the common biscuit sizes—0, 10, and 20. A biscuit swells in thickness (right) when wet glue hits it, helping to anchor the joint. So store biscuits in a sealed jar to keep out moisture.*

A variety of uses

Biscuit joinery is useful in a wide range of applications, from aligning edge-glued boards to securing shelves to assembling and attaching frames, miters, and more.



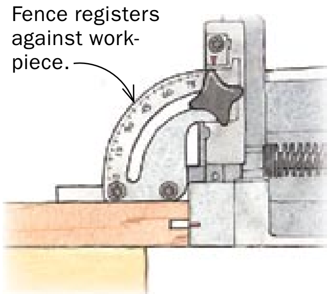
Photos: Steve Scott; drawings (facing page): Stephen Hutchings

Reference off the fence

Using the fence to locate the cut lets you adjust the position of the biscuit slot to any point between 3⁄16 in. and 1 in. from the reference surface.

Layout is simple. *Just align the workpieces, then draw a line across the mating faces to mark the centerline of the biscuit.*

Center the cutter on the stock's thickness. *With the fence flat on the workpiece, adjust its height to locate the cut. To make the cut, simply align the joiner with the single layout mark, start the tool, and push the joiner's body forward.*



remember not to flip the parts when it comes time to glue them.

Cut and assemble a simple biscuit joint

With a biscuit joiner in hand, it takes just four steps to join a pair of ¾-in.-thick boards end to edge (see photos, left). This joint is useful for making light-duty door frames, especially when the panel is plywood or MDF. That's because plywood and MDF don't expand and contract with changes in humidity, so they can be glued in place to add strength to the frame.

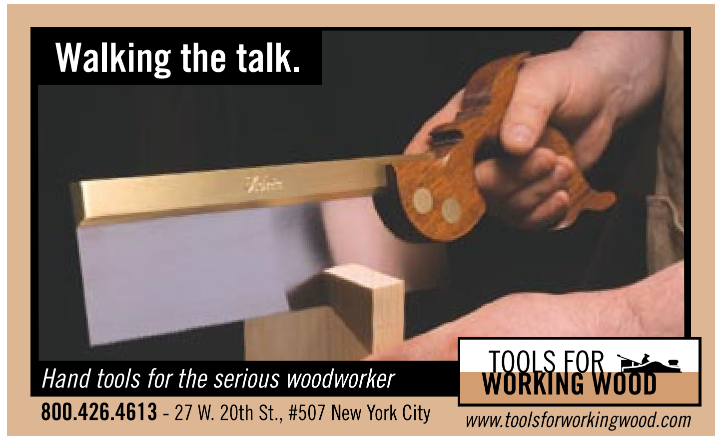
Step 1: Align and mark—Align the boards as you want to see them joined, and use a single line to mark the biscuit centerline on the top face of both parts.

Step 2: Determine the biscuit size—Based on the width of the board, choose

ANGLE THE FENCE FOR MITERS

Setting the fence to 45° allows the joiner to cut a slot in the end of a mitered workpiece. Align the joiner for a cut toward the inside of the miter, so there is plenty of material in which to sink the slot.

Drawings, except where noted: Jim Richey



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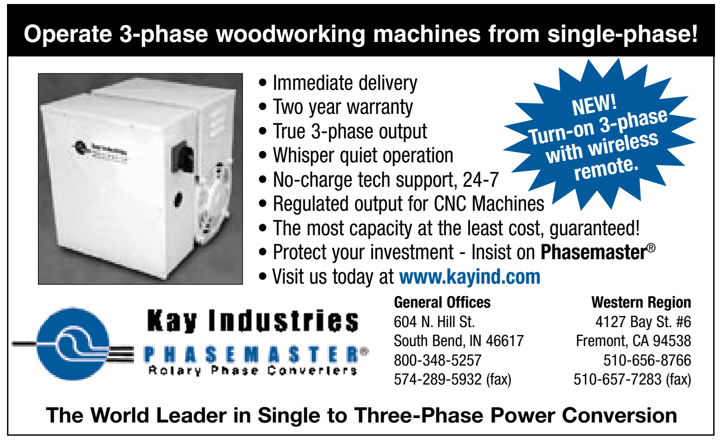

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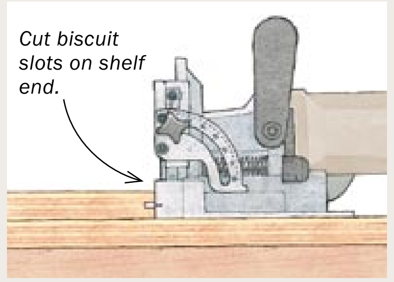
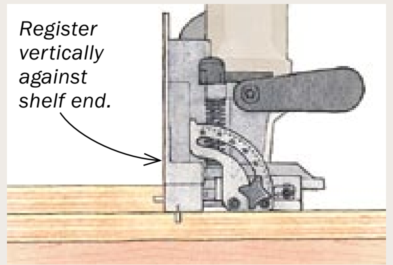
Reference off the base

Registering a cut from the joiner's base always puts the biscuit slot ⅜ in. from the reference surface, or centered on ¾-in. stock. This can make for quick biscuiting, as when attaching a fixed shelf to an upright.

Layout trick. *To start, mark out the shelf location on the case side and clamp the actual shelf along one of those lines. You are now set up to cut both sides of the biscuit joint.*



Just butt and cut. *With the joiner base on the side piece, cut the biscuit slots in the end of the shelf (above). Reposition the joiner so the base butts against the end of the shelf, and cut the mating slots in the side piece (below).*



the largest biscuit that it can accept. For the 3-in.-wide stock shown, No. 20 biscuits are a good choice.

Step 3: Cut the slots—Clamp one of the workpieces in place (never hold the workpiece by hand). Set the depth-adjustment knob for the No. 20 biscuit. Align the center-registration mark on the biscuit joiner with the biscuit-centerline mark made in step one. Start the motor and, with one hand on the top handle and one hand on the motor housing, push the motor toward the stock. Continue cutting until you reach the stop, and then allow the spring action to return the motor to the starting point. Repeat the process to cut a slot in the second piece.

Step 4: Apply glue—Use a small brush (I use a throwaway soldering brush) to apply a generous coat of glue to each slot. Be sure to coat the sides of the slots—that's where a lot of the glue strength comes from. Add glue to the biscuit and insert it into one of the slots, then attach the other piece and clamp them together. Don't answer the phone after the biscuit has been inserted into the first slot. By the time you come back, it will already have swelled enough that you won't be able to insert it in the second part of the joint. The only thing you can do then is let the glue dry, saw away the protruding part of the biscuit, and recut the slot. □

Join the parts. *Apply glue to the slots and biscuits, then fit the shelf to the side pieces and add clamps.*

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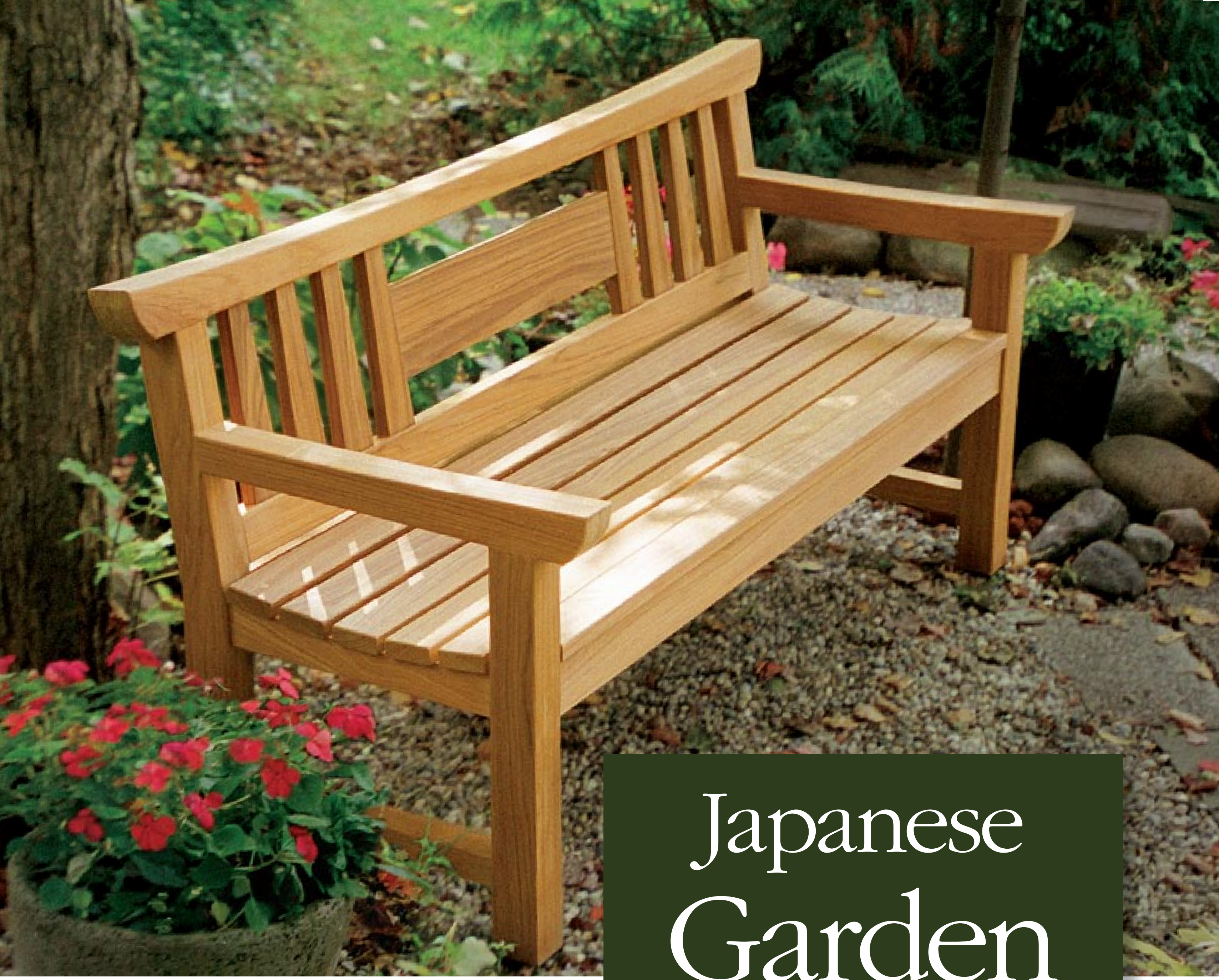


Japanese Garden Bench

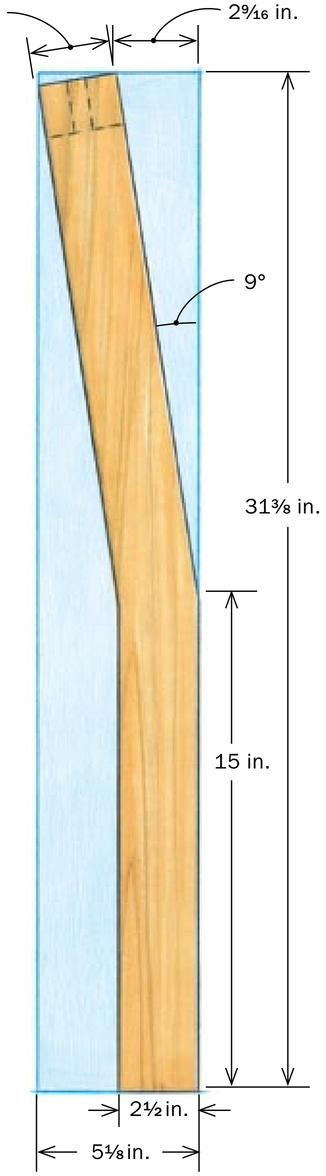
Mortise-and-tenon joinery and outdoor-friendly materials ensure a long, happy life

BY RUSSELL JENSEN

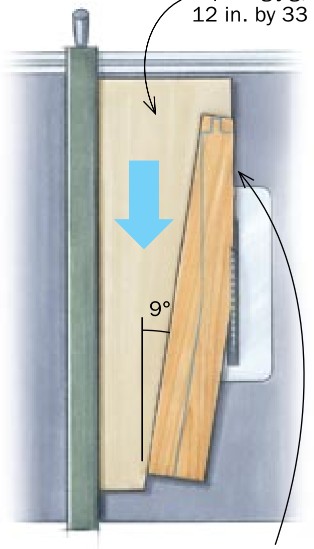
A client approached me about a Tudor-style garden bench I had made for the local university. She loved the bench, but wanted something more Asian in style. I decided to incorporate elements from Gary Rogowski's Asian-style bed (*Home Furniture* #8, p. 43; also shown in gallery on FineWoodworking.com), adding a curved back rail and armrests as well as tapered back splats with a cross rail between them. The final design is a blending of Asian aesthetics and traditional Tudor style. The curved top rail, armrests, and tapered splats are very reminiscent of Buddhist temple gates in Japan, while the straight, chunky front legs and angled back legs are strictly Tudor.

Since this is an outdoor bench, I used teak. Highly weather resistant, teak is my first choice and is worth the expense and extra care it takes to work, but there are less-expensive woods such as Spanish cedar, white oak, ipé, and jatoba that also work well outdoors. This bench is built almost entirely with mortise-and-tenon joints, and because there are so many, you'll need an efficient way to crank them out. I'll demonstrate a simple template-guide jig for the mortises, and time-tested methods for making tenons to fit. Even though teak can be tricky to glue, the combination of mortise-and-tenon joinery and marine epoxy ensures the bench will last.

SHAPE THE REAR LEGS



Use a tapering jig for the front angle. *After cutting close to the line on the bandsaw (left), make a simple tapering jig to clean up the cut on the tablesaw (below).*



Trim waste on bandsaw before cutting final taper.

Make stop cuts on the back. *Jensen cuts close to a pencil line, and then turns off the saw before removing the piece and flipping it to cut the other end (left). A quick stop at the spindle sander cleans up the waste that remains (below).*

Choosing and milling the stock

I made the bench out of 4/4, 6/4, and 8/4 teak. Start by rough-cutting the lumber a couple of inches longer than you need. All the 2½-in.-thick parts, such as the legs, arms, and curved back rail, are made of 6/4 stock glued together with West System epoxy. I do this because 12/4 teak is expensive and hard to find, but it is a good idea regardless of the wood. When choosing

Photos, except where noted: Anissa Kapsales; this page: Russell Jensen

stock for the rear leg, steer away from using plainsawn stock on the front of the leg, as this will result in an unattractive, stepped-grain pattern when the angle is cut.

After gluing the legs, arms, and rear rail, allow the epoxy to cure and then mill all the lumber to thickness. Now true up all the edges on the jointer and rip everything to width. To give yourself a little play when cutting out the patterns, leave about ¼ in. extra on the width of the curved pieces and tapered back splats.

Shape the rear legs

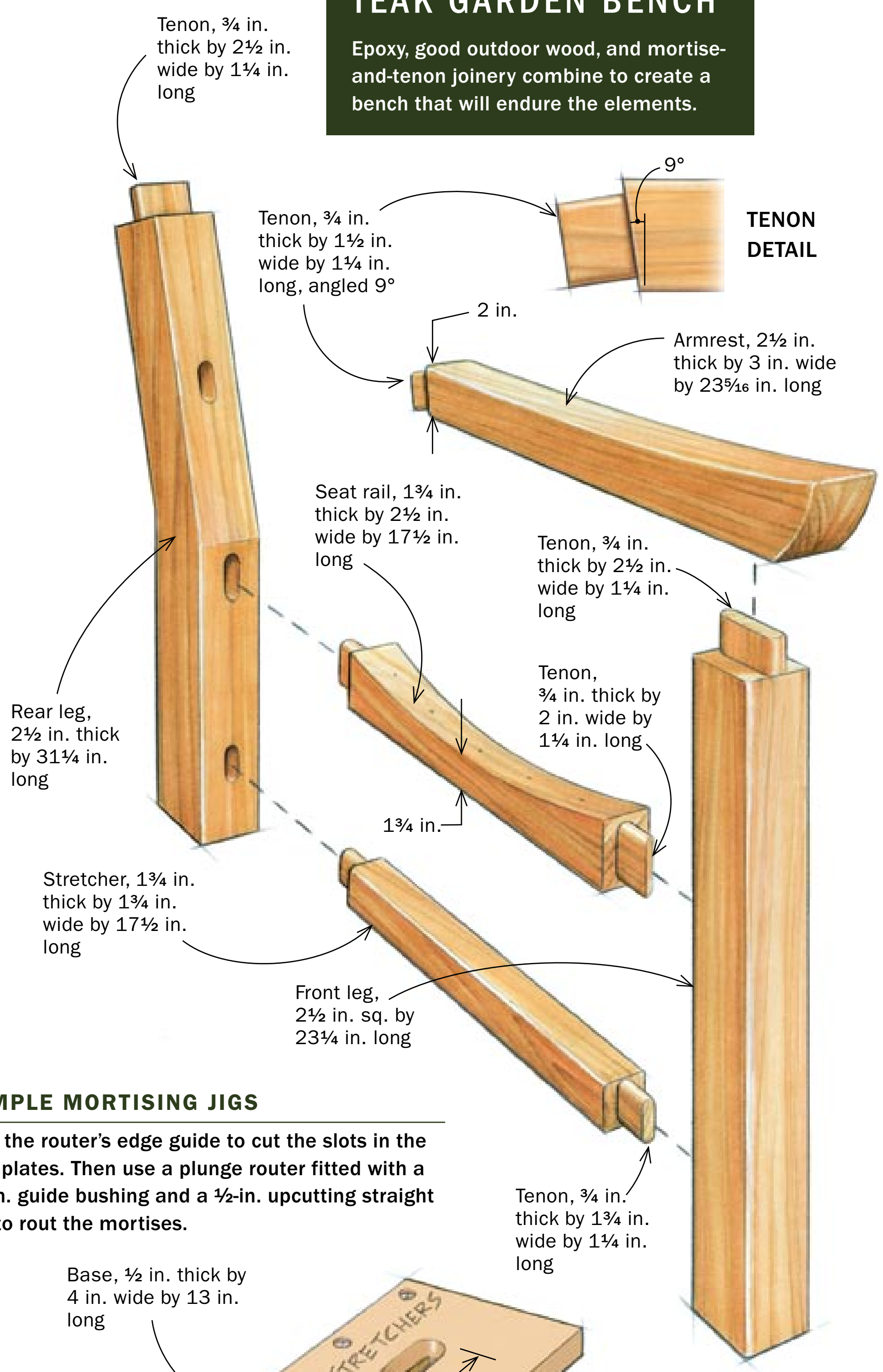
The straight, square front legs are easy to mill and lay out. The rear legs are more of a challenge. First, lay out the shape on the blanks. Then rough out the front angle at the bandsaw, staying 1⁄16 in. proud of the line. Now use a shopmade tapering jig on the tablesaw (see photo, p. 39) to cut a clean taper. Even though the bandsaw is an extra step, removing most of the waste first makes for a cleaner and, more importantly, safer tablesaw cut. Next, rough out the back of each leg at the bandsaw, followed by a series of stop cuts at the tablesaw to clean up the bandsaw marks and size the leg to 2½ in. The material that is left can be cleaned up with hand tools or at the spindle sander. With the rear legs cut to shape, cut them to length.

Quick, accurate mortises with a router

There are 40 mortises of four different lengths in this bench, but you can simplify the process

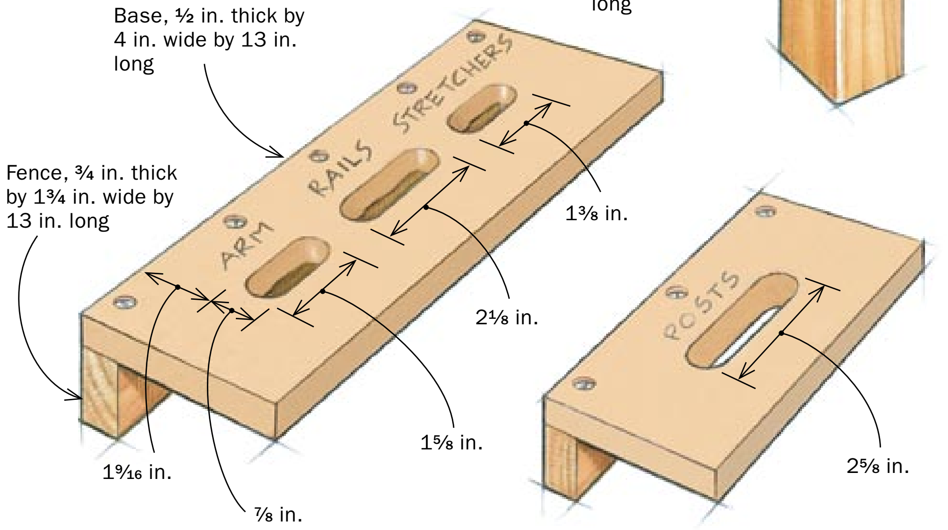
TEAK GARDEN BENCH

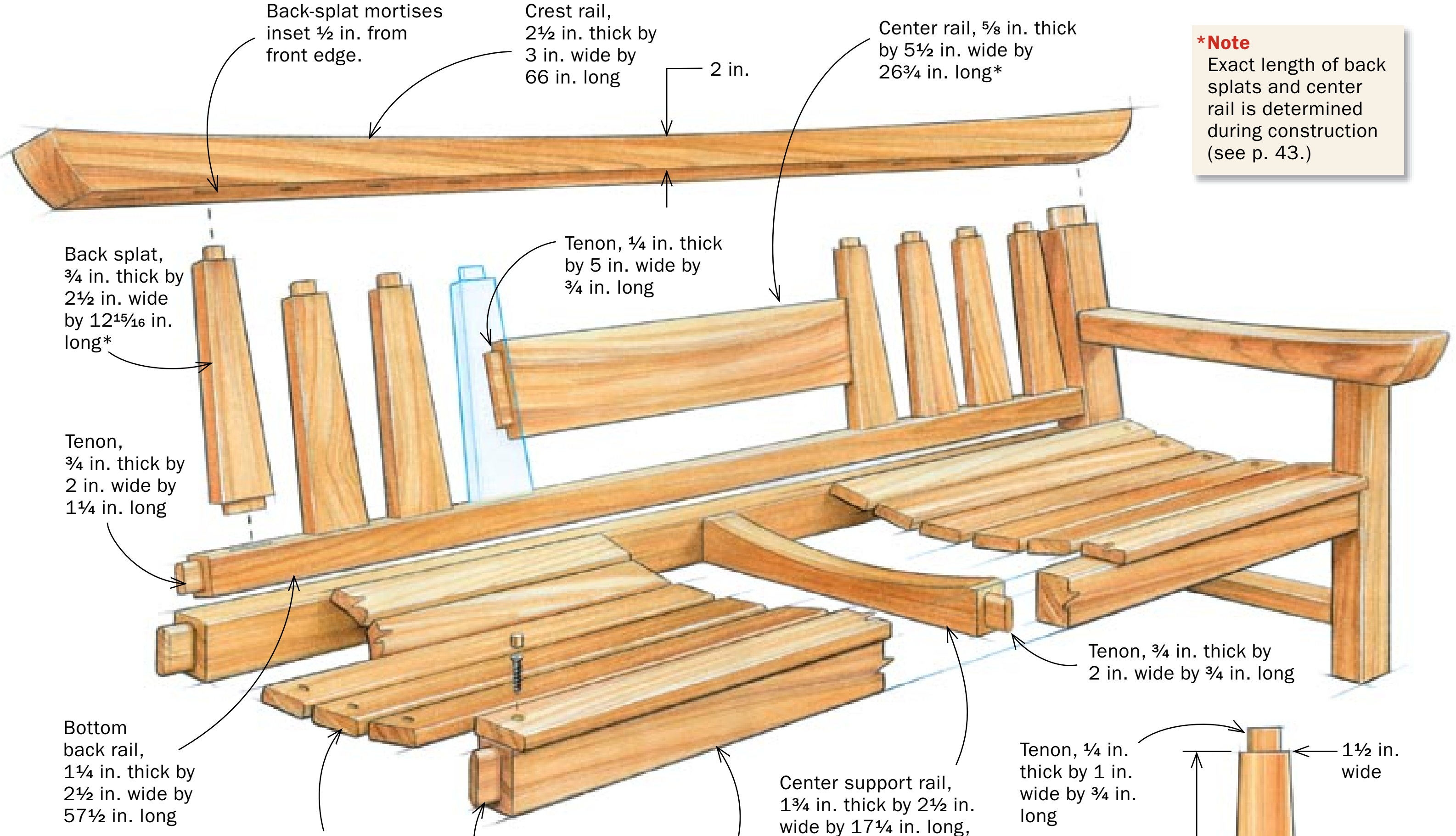
Epoxy, good outdoor wood, and mortise-and-tenon joinery combine to create a bench that will endure the elements.



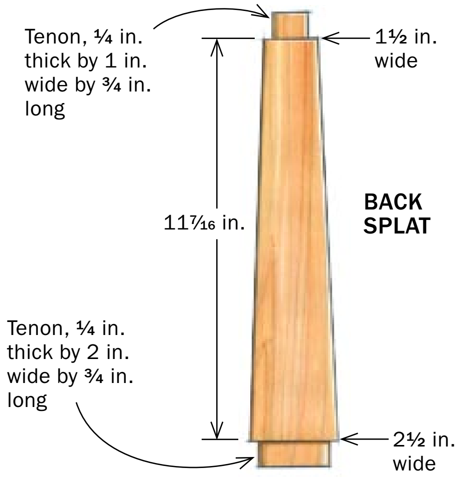
SIMPLE MORTISING JIGS

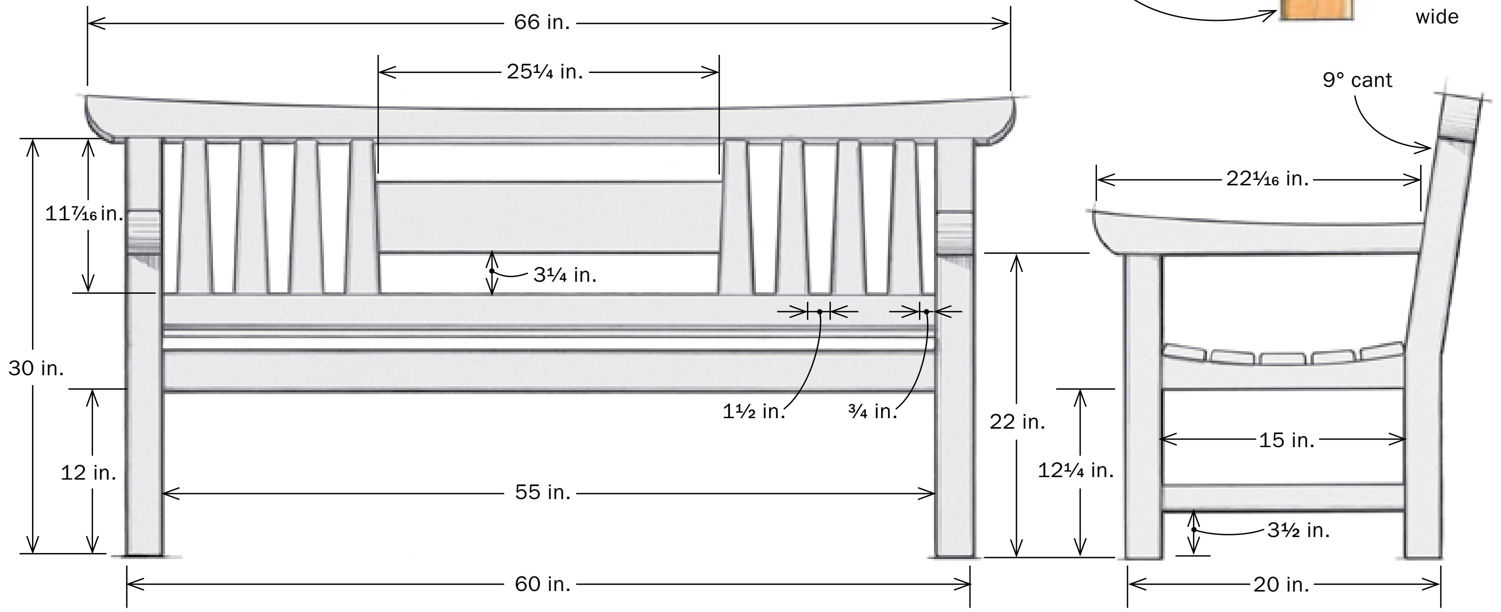
Use the router's edge guide to cut the slots in the templates. Then use a plunge router fitted with a ⅝-in. guide bushing and a ½-in. upcutting straight bit to rout the mortises.





Full-size plans for this bench and other projects are available at FineWoodworking .com/PlanStore.





Drawings: Bob La Pointe

CUT ANGLED TENONS ON THE ARMRESTS

Cut stock to size. *Use a miter saw to cut the blank to size with a 9° angle at the tenoned end.*

Cut the shoulders and cheeks. *Place the angled end against the rip fence to set the miter-gauge angle and cut the shoulders. Then cut the cheeks using a tenoning jig, keeping the end flat against the tabletop.*

Move to the bandsaw. *Once you've cut the cheeks and shoulders, use the bandsaw to make the angled cuts at the top and bottom of the tenons and a handsaw to trim the remaining material.*

MORTISE, THEN SHAPE THE CREST RAIL

Mortise for the back splats. *A plunge router equipped with a guide fence makes cutting these mortises a snap (above). To lay out a graceful curve on the top edge (right), Jensen puts a clamp on each end, rests a strip of MDF against the clamps, and pulls the strip back, clamping it in place at the center.*

using two easy-to-make jigs. Most of the mortises are ¾ in. thick, located where the legs meet the arms and where the legs meet the stretchers. I use jigs for these.

Sixteen smaller mortises join the back splats to the top and bottom stretchers that make up the back assembly. I make these by carefully laying them out and then outfitting my plunge router with an edge guide.

Once you have marked the mortises on all four legs, use a router equipped with a template guide and a jig. Each jig is ½-in. MDF with a hardwood fence screwed to it, and a corresponding slot routed in the MDF for each different-size mortise (see drawing, p. 40. To make the jigs, mark the MDF and plunge the router in and along using the router's guide fence. Because I use a ½-in. upcutting spiral bit and a ⅝-in. template guide to make the ¾-in. mortises, my template holes have to be ⅛ in. longer and wider than the actual mortise. Making accurate jigs is essential to creating perfectly centered mortises, so testing them on a piece of scrap is always a good idea.

Rounded tenons for routed mortises

For the tenons, start by making the shoulder cuts on the tablesaw. Clamp a short stop block to the rip fence, and set the tenon length from the stop block to the far side of the blade. The block keeps the piece away from the fence as you make the cut and prevents a dangerous binding or a crooked cut. After adjusting the blade height, make all the shoulder cuts, then use a shopmade tenoning jig to make the cheek cuts. I cut the tenons to height on the bandsaw and complete the top and bottom shoulder cuts with a handsaw, cleaning up any roughness left from the handsaw cuts with a sharp chisel.

When making the back shoulder cut on the top of the rear leg, elevate the leg with a ¾-in. shim so the lower, angled part of the leg doesn't interfere with the cut.

To fit the tenons in rounded mortises, make four small chisel incisions where the shoulder meets the corners of the tenon, and round over the corners with a rasp.

Angled armrests are a fun challenge

Making the armrests is tricky, due to the angled tenon that fits into the rear leg mortise. First, set a miter saw at 9° and cut off the end of the blank where the tenon ends. Then move to the tablesaw. Instead of relying on the angle gauge, use the angle on the end of the arm blank, resting it against the stop block and angling the miter fence to meet it. Then cut the shoulder on both arms, adjust the miter gauge to the other side of 9°, and cut the other shoulder. Next, bring the arms to the tenoning jig, lay the 9° angle flat on the table, clamp it into the jig, and cut the tenons. Again, lay out the width of the tenon and cut it freehand on the bandsaw. Then remove the waste with a handsaw and round the edges with a rasp.

Curved pieces create an Asian feel

Now you are ready to cut the curves for the armrests and crest rail. Again, careful layout is the key. With a pencil, draw the shape directly on the stock. Create the radius at the ends with a compass. For the long curves, I simply bend a thin piece of MDF, held back by clamps, and trace the line. Step back and look at the lines, redrawing them until they look good.

Once I have settled on the shape, I cut it close to the line on the bandsaw, and then finish at the spindle sander or with a sanding drum on the drill press. If you are unhappy with the smoothness of the curve after using the spindle sander, some aggressive sandpaper, a slightly curved sanding block, and good old-fashioned elbow grease will smooth out the curve nicely. When I have to make two identical parts, like the armrests, I work one at a time, using the first piece as a pattern for the second. I do this because the stock is thick. Ganged together, it measures 5 in., and I can only sand up to 4 in. with my spindle sander.

Use two jigs to taper the back splats

I dry-fit and clamp the whole bench except for the armrests. Doing this allows me to measure for the back splats. I can determine their exact length from shoulder to shoulder, cut the tenons while the pieces are still square, and then create the taper. After I've accurately measured the size of the back splats, I make the tenons using the same method used previously.

The center rail is joined to the two center splats with a mortise and tenon. It is easier to cut the mortises in the two center splats before proceeding with the tapers. This

MAKE THE SPLATS

Real-world measurement. *Dry-fitting makes it easy to measure the exact shoulder-to-shoulder dimensions of the back splats.*

Taper the back splats after cutting the tenons. *Use two jigs to create the tapered back splats. The first holds the square splat and the second (shown) holds the splat that has one side already tapered.*

Mark the center rail. *Add the tapered back splats to the dry-fit assembly, and clamp the center rail in position so you can mark its tenon shoulders.*

GLUE UP IN STAGES

Start with the ends. *After cleaning the joints with acetone (teak's oily properties make this a necessity), Jensen glues and clamps the two end sections (above). The easiest way to glue and assemble the bottom rail, the seat rail subassembly, and the two ends is on end (right). Then tip the bench upright and clamp.*

Glue the center rail to the center back splats. *Jensen uses the cutoff pieces from the tapering process to create a square clamping surface (above). The tapered back splats, center rail, and crest rail complete the glue-up (right).*

is accomplished the same way as the other mortises for the back splats. Lay out the position of the mortises on the two center splats, use double-sided tape to attach the piece to a larger block of wood (to safely balance the router), and cut the mortises. Once the mortises are complete, cut the tapers in the splats using tapering jigs. Keep a couple of the cutoffs from the tapering process to help out when gluing the center rail to the two splats.

Join the center rail to the back splats

Even though teak is very stable, I still like to make the center rail from a quartersawn piece that has the grain running as perpendicular to the face as possible. This offers a clean look and also minimizes expansion and contraction of the tenon.

Once you've added the tapered back splats to the dry-fitted bench, mark where the bottom of the center rail will intersect with the two back splats. Align the two lines to the bottom of the center rail, clamp it to the splats, and trace out the two inside angles with a very sharp pencil. Transfer that same angle about 1/16 in. past where the tenon will end and cut off that angle at the miter saw. Now you can proceed to make the shoulder cuts and tenons the same way as on the angled tenon of the armrest. Cut the tenons to final length after they are made.

Support rail eliminates flex in seat

Because the bench has a span of almost 5 ft., it is essential to mount a support rail to stop excessive flex under the seat slats. The center support rail is essentially the same as the two end rails, but is 3/4 in. longer because it goes directly from the front rail to the back rail, rather than front leg to back leg as the end rails do.

For the mortises, refit the jig used for the end support rails. Unscrew the wooden fence on the side of the jig and then calculate where it needs to be attached above the guide hole. Find the center on the insides of the front and back rails of the bench, clamp the jig down, and rout the mortises. After you have made the tenons on the blank, find the center on it and one of the end support rails. Put them together, lining up the center marks, and transfer the curve onto the center rail. You can then proceed to cut out the curve at the bandsaw, and take it down to the line at the spindle sander.

While the bench is still clamped, predrill and counterbore for the seat slats. This will be almost impossible after the armrests are glued in place.

Before gluing up the bench, I put a 1/4-in.-radius roundover on all the exposed edges, being careful not to rout past the points where one piece joins another (I mark these transitions during the dry-fit). Rough transitions can be cleaned up with hand tools after glue-up.

Glue the bench in sections

I use slow-curing West System epoxy to glue the bench together. Its 50- to 60-minute open time eliminates drama in the workshop. I recommend breaking the glue-up into a few sessions.

Glue up the two ends first. Since some of the mortises intersect, it's important to lay down the assembly so that no epoxy gets into the adjoining mortises.

The next step is to glue the two long seat rails and the lower back rail into the two end pieces. This step requires three 6-ft.-long clamps.

Now, to prepare for the final assembly, glue the center rail to the two center splats. You can use the two cutoff pieces saved from the tapering process on the outside tapers to provide a square surface to clamp. Glue the center support rail to the front and back seat rails. After this has dried for 24 hours, clean up any squeeze-out with a sharp chisel. The final gluing is to join the tapered back splats and the curved top rail. This is where the slow-cure epoxy really comes in handy.

Now you can screw the seat slats into place with 1½-in. stainless-steel screws and use a tapered plug cutter to make plugs for the counterbored holes. Glue the plugs into place and let them dry before cutting them flush to the seat slats.

Teak is a fascinating wood. Incredibly durable, it can survive outdoors untreated for decades. In fact, left unfinished it becomes more beautiful as it ages. Because of this, I leave the bench as is, except for "painting" the bottoms of the legs with epoxy to ensure that no water wicks into the end grain. □

Russell Jensen is a furniture maker in Sudbury, Ont., Canada.

Plug the screw holes. *After screwing the seat slats down, glue in plugs, then cut them flush.*

Seal the legs. *Seal the bottoms of the legs by coating them with the same epoxy used in the glue-up.*

Marking Knives

These must do more than follow a straightedge

BY STEVE LATTA

The marking knife seems like such a simple tool that it would be easy to dismiss it as little more than a blade and a handle. But we all know better: Marking out with a knife instead of a pencil means that you care about the details. So it makes sense to focus on the details when choosing the knife. A good marking knife will do a number of things well. It will cut wood fibers cleanly, leaving a narrow, crisply defined line, easily visible and deep enough to anchor a chisel. The blade will fit into tight spaces and the tool will be easy to hold in a pencil-style grip.

That said, individual needs and preferences do play a role in choosing a knife. I do a lot of inlay, for example. For me, a skew point with two bevels and a slightly flexible blade is key for accurately marking out bellflowers and bandings. Also, because I move around a lot between student benches in a large shop, I favor a small, lightweight knife that I can carry in my apron. You might be surprised to learn that I've used a simple X-Acto for many years.

My friend Bess, on the other hand, builds tall-case clocks with huge dovetails in their hoods. She finds a large marking knife with a long, thick blade best suited to the task. Fellow contributing editor Chris Becksvoort recommends having a variety of marking knives handy but says he personally favors a straight chip-carving knife. The bottom line: One size or style does not fit all.

I sought to keep that in mind and to set aside my own preferences as I sampled more than a dozen knives representing the most common designs among the many knives on the market. Some are specifically for layout. Others are carving or craft knives popular with woodworkers as layout tools. I was eager to see whether any of them would make me want to give up my trusty X-Acto.

A good knife handles a variety of tasks

I put each knife through five tests, each a real-world woodworking task:

Scoring a line—With the blade riding against a combination square, I struck a line

And the winners are ...

Three knives scored very highly on the full range of tests, with hardly a scribe line of space between them overall. Each had its own unique strengths. The Blue Spruce felt great in the hand, and its long, reinforced spearpoint blade and flat back made it a champ at laying out dovetails. Hock's double-beveled skew point features a heavy blade that stayed solidly on track in all situations. The X-Acto's thin, flexible blade left a deep, narrow line, carried a line easily around a corner, and was nimble enough to trace delicate inlays. The slim cylindrical handle fit comfortably in the hand and in an apron pocket.

I'm hard-pressed to pick a favorite among these three—any one of them would be a smart buy. However, the low cost of the X-Acto makes it a perfect first knife. It may be a long while before you need a second.

Online Extra
To see how Steve Latta tested the knives, go to **FineWoodworking.com/extras.**

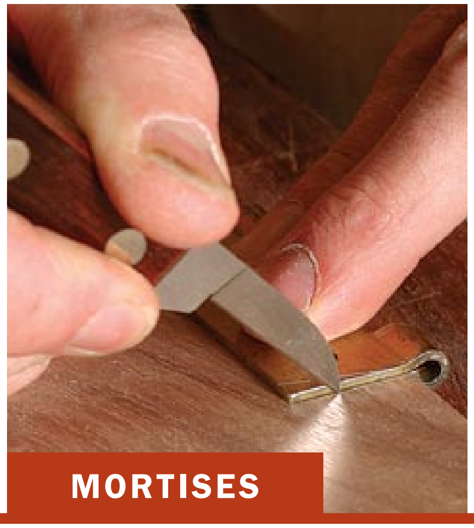
Five tests for a good knife

SCRIBING

Scoring a line against a rule. *Latta looked for cleanly defined, narrow lines deep enough to anchor a chisel.*

DOVETAILS

Marking for dovetail pins. *The narrow spacing of these dovetails puts a premium on blade size and shape, testing each knife's ability to strike a line in confined quarters.*

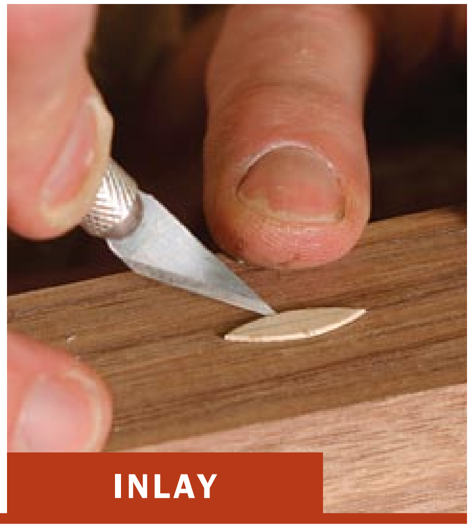


MORTISES

Tracing a hinge. *This involves cutting both with and across the grain. After tracing the hinge, Latta made the lines deeper, testing how well the knife tracked in a channel.*

BANDING

Marking for a banding. *This task is easier with a knife that works well cutting either toward or away from the user. The test also gauged a knife's ability to carry a line around a corner.*



INLAY

Tracing the boundaries of an inlay mortise. *A flexible blade works best for this intricate work. The lines must be crisp, but not too wide, because the inlay must fit tightly in the recess.*

Photos: Steve Scott

Marking knives

SINGLE-BEVEL SKEW

These tapered blades, beveled on one side, are often sold in matched pairs. They are meant to be pulled in one direction with the flat back riding against a straightedge. Reversing direction for bandings or mortises was a challenge. For closely spaced dovetails, where the beveled side of the blade must ride the reference surface in tight quarters, the thicker blades simply couldn't do the job.

DOUBLE-BEVEL SKEW

These perform equally well with either side against the work, so you can use them in either hand, whether pulling toward or away from you. The bevels on most are shallow enough that the edge can be held tight to the work without angling the knife too steeply. As with the single-bevel skews, the wider blades sport a much longer edge than is necessary.

SPEARPOINT

These knives, single beveled with a pointed tip, performed consistently well. The blade shape allowed them to easily mark crisp lines going in either direction. Steeper points like those on the Hock and Blue Spruce left the most precise lines and easily fit into the spaces between dovetails. Models with thicker blades may feel sturdier; the tradeoff is a wider line at any given depth.

CARVING KNIVES

Characterized by long, narrow, twin-bevel blades that resemble those on a small pocket knife, most of these performed adequately, leaving fair to decent line quality. The blade's narrow profile and long reach make it great for tight spaces. The Flexcut had an excellent blade, but its handle, designed for rough carving, wasn't suited to the pencil-style grip that is best for layout.

MODEL/SOURCE	STREET PRICE	SCORING WALNUT / MAPLE	DOVETAILS	HINGE	BANDING	INLAY	COMMENTS
SINGLE-BEVEL SKEW KNIVES							
Crown Tools www.rockler.com	$12	Good / Fair	Very good	Good	Fair	Good	Can be purchased in left- and right-handed pairs.
Japanese marking knife www.highlandwoodworking.com	$13	Good / Fair	Poor	Fair	Good	Good	Back is hollow ground for easier sharpening.
Laminated marking knife www.toolsforworkingwood.com	$12	Very good / Very good	Very good	Good	Poor	Fair	Excessive blade length makes some tasks awkward.
Narex ½ in. www.highlandwoodworking.com	$20	Fair / Fair	Poor	Fair	Fair	Good	Thick blade and short bevel performed poorly in tight quarters.
DOUBLE-BEVEL SKEW KNIVES							
GarrettWade www.garrettwade.com	$30	Good / Good	Good	Good	Poor	Fair	Excessive blade length is awkward.
AUTHOR'S CHOICE BEST OVERALL **Hock violin knife** www.hocktools.com	$31	Very good / Excellent	Very good	Very good	Excellent	Good	A single piece of steel forms both blade and handle.
Western pattern knife www.japanwoodworker.com	$19	Very good / Excellent	Very good	Very good	Very good	Very good	Similar in design and appearance to the Hock.
AUTHOR'S CHOICE BEST OVERALL, AUTHOR'S CHOICE BEST VALUE **X-Acto No. 1 knife** www.staples.com	$4	Excellent / Excellent	Very good	Very good	Excellent	Very good	Package of 5 Modified #11 replacement blades, under $3 at www.dickblick.com
SPEARPOINT MARKING KNIVES							
AUTHOR'S CHOICE BEST OVERALL **Blue Spruce Toolworks** www.bluesprucetoolworks.com	$45	Excellent / Excellent	Very good	Very good	Very good	Very good	Versatile blade design, comfortable turned handle
Chester Toolworks www.chestertoolworks.com	$39	Very good / Very good	Very good	Very good	Good	Very good	Thicker blade than Blue Spruce
Hock marking knife www.hocktools.com	$31	Excellent / Very good	Very good	Good	Very good	Good	Like Hock's violin knife, can be fitted with a wooden handle.
Blue steel www.japanwoodworker.com	$18	Excellent / Very good	Very good	Fair	Good	Good	Back is hollow ground.
CARVING KNIVES							
Flexcut roughing knife www.leevalley.com	$21	Excellent / Excellent	Good	Very good	Very good	Good	Terrific blade. Handle shape is awkward for some layout tasks.
Oar Carver www.toolsforworkingwood.com	$32	Very good / Excellent	Very good	Very good	Very good	Good	Sturdy blade, comfortable handle
Chip-carving knife www.woodcraft.com	$15	Fair / Fair	Good	Fair	Fair	Good	Common straight-blade chip-carving design
Two Cherries chip-carving knife www.toolsforworkingwood.com	$19	Good / Good	Good	Fair	Good	Good	Design very similar to Woodcraft

across 5-in.-wide pieces of walnut and curly maple. I was looking for quality of line in both softer and harder material.

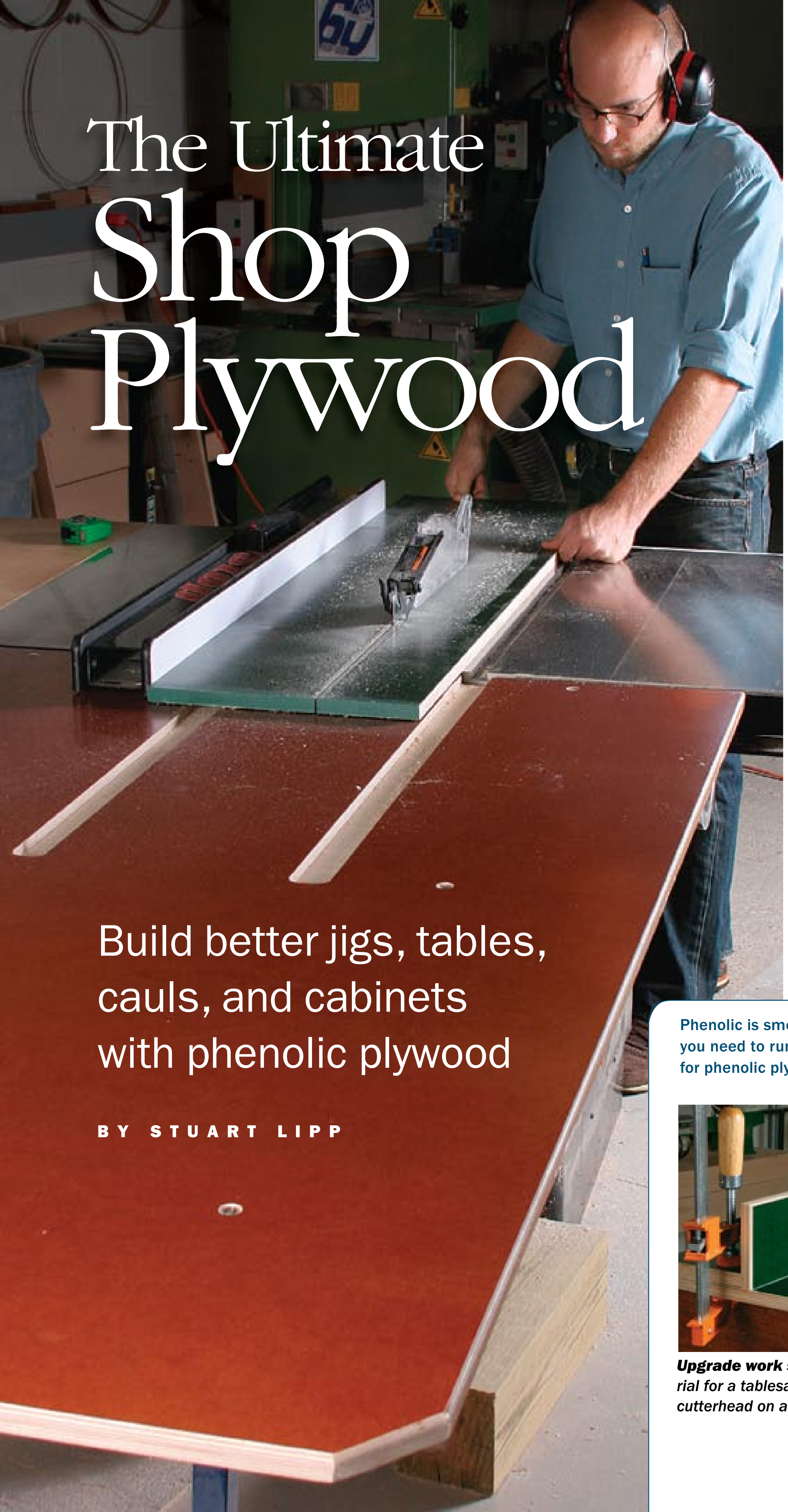
Dovetailing—I marked out a pin board for a set of narrowly spaced tails across a 6-in.-wide piece of ¾-in. stock. The narrow spacing tested each knife's ability to strike a line in confined quarters.

Laying out for a hinge mortise—I set a 1-in. by 2½-in. hinge against the edge of a walnut board and traced it out. This involves cutting both with and across the grain. I set the marking knife on the edge and cut back to the rear of the plate. Then I removed the hinge and made the lines deeper by running the knife in the channel. This tests the knife's ability to track in an already established groove.

Marking out for a banding—I scored one line running all the way around a tapered walnut table leg, pulling the knife away from me. I then ran a second line with the knife coming toward me. This test helped me gauge the ease of handling the knife and whether both sides of the blade could easily be held tight to the work. It also demonstrated how easily each knife could carry a line around a corner.

Tracing for a bellflower—This is intricate work best done with a thin blade. A line is scored around a small petal and then excavated with a tiny router plane. The knife lines must be precise enough to ensure a snug fit for the inlay and deep enough to provide a stop for the router plane's iron. The line must be crisp but not wide, or the final recess will be too big. □

Steve Latta teaches woodworking at Thaddeus Stevens College in Lancaster, Pa.



The Ultimate Shop Plywood

Build better jigs, tables, cauls, and cabinets with phenolic plywood

BY STUART LIPP

On my first day working in the pattern shop at Steinway & Sons, I was introduced to a great material that has changed my woodworking. Phenolic-surfaced plywood is Baltic-birch plywood that has a thin coating of phenolic resin on its faces. Used in electrical panels and switches because of its stability and strength at high temperatures, phenolic resin makes this plywood very resistant to moisture, heat, chemicals, and abrasion. Phenolic plywood also has superior strength, flatness, and durability compared to other types of plywood. Its nonstick, glassy surface makes it popular in the concrete industry, where it is used to make forms and molds.

All of these qualities combine to make phenolic plywood ideal for many woodworking applications—from jigs, fences, and cauls to work surfaces and cabinets. Anywhere a jig or workpiece needs to slide over a surface or you don't want glue to stick is the perfect place for phenolic plywood. It is manufactured in 4-ft. by 8-ft. sheets, in thicknesses of ½ in. (12.7 mm) or ¾ in. (19 mm).

How to get phenolic

Phenolic plywood is a specialty material, so don't expect to find it at your local home center. It has been around for a while, though, under such aliases as Colorfin, Parklex, Eurocolor Ply, Wisa, and Finnform. Color options are light brown, dark brown, red, black, green, yellow, white, or clear. However, suppliers tend to purchase one color in bulk and ordering specific colors can add to the price. Cost varies quite a bit from supplier to supplier, from $54 to $140 for a full sheet of ¾-in. material. The difference depends on the inventory and colors the supplier stocks.

Woodcraft sells quarter-sheets of ½-in. and ¾-in. phenolic. White Cap Construction Supply stocks it and has over 150 stores across the United States, but few in the Northeast. A few smaller suppliers are Anderson Plywood in California, McCausey

Working with phenolic

Phenolic plywood machines like any other plywood product and doesn't dull blades excessively. The resin coating can chip out a little, but using sharp blades eliminates this. Beware: Freshly cut edges can be very sharp, so you should definitely break them with sandpaper or with a roundover bit.

Attaching hardware is not a problem. Screwing into the face can crack the phenolic resin, but pilot holes and a quick hit with a countersink bit eliminate this. Pilot holes are especially important to avoid splitting the layers when you screw into the edges of the plywood.

Sharp edges. *Break all edges with sandpaper or a roundover bit (shown).*

FOR MACHINES

Phenolic is smooth, durable, and low-maintenance. Any place you need to run workpieces across a surface is a good place for phenolic plywood.

Upgrade work surfaces. *Phenolic plywood is a perfect material for a tablesaw outfeed table (left). Workpieces glide past the cutterhead on a router table with a phenolic top and fence (above).*

Plane thin stock. *Screw a cleat to a long piece (above) to make a smooth-sliding auxiliary bed for surfacing very thin workpieces on your planer (right).*

Easy to clean. *A countertop wipes off easily with a damp rag.*

Photos: Anissa Kapsales

FOR FENCES AND JIGS

Whether a jig needs to move fluidly over a surface with the workpiece locked in place or a workpiece has to slide effortlessly across a fence, a phenolic surface is ideal.

Versatile tablesaw fence. *The shorter, sacrificial side is used with a dado set to cut rabbets (left). The tall side is perfect for raising a panel (above). The extra height supports the tall panel as it slides easily across the fence.*

Slick jigs. *A phenolic-plywood tapering jig rides in the miter slot and across the surface of the tablesaw. Since the blade also trimmed the edge of the jig, that edge is the reference line.*

Lumber in Michigan, and Roberts Plywood in Deer Park, N.Y. (my supplier).

Use for jigs, surfaces, and cauls

When it comes to improving machinery performance and jigs, phenolic plywood is at its best. The surface is so slick that other materials glide over it, making it perfect for all types of jigs and work surfaces. The top surface of a shopmade router table is a good place to use phenolic. So is a tablesaw outfeed table. Made of phenolic, it will perform better than a basic plywood table or a roller stand, and can double as a glue-up table. Dried glue pops right off.

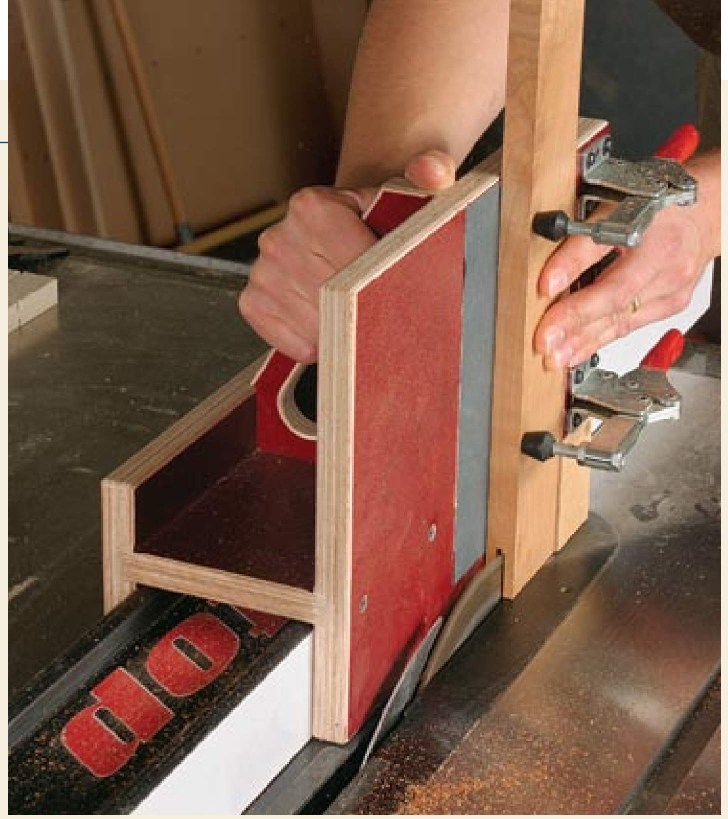
Tablesaw and router-table fences faced with phenolic plywood give you a superior surface that is replaced easily if damaged. Also, any jig that will slide over the surface of a machine should have a base made of phenolic plywood. Whether it is a template to be used on the shaper or a tapering jig for the planer, it makes the machining process much easier because friction and drag disappear, giving you a steadier feed rate and better results.

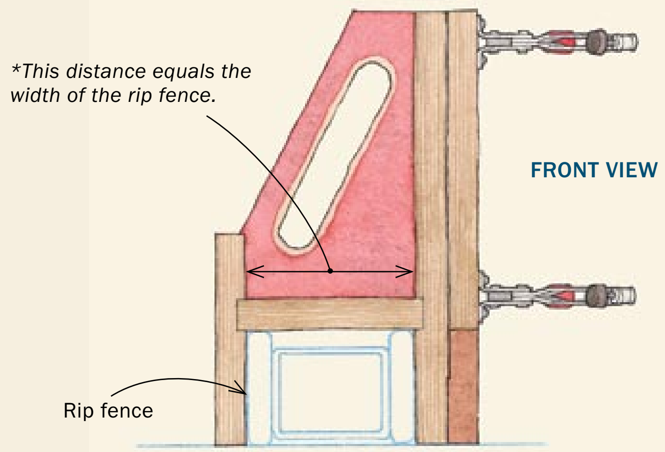
Phenolic also is very easy to clean with a damp rag, so I find myself using leftover pieces for surfaces that tend to collect a lot of dust or debris, such as those under sharpening stations or grinders.

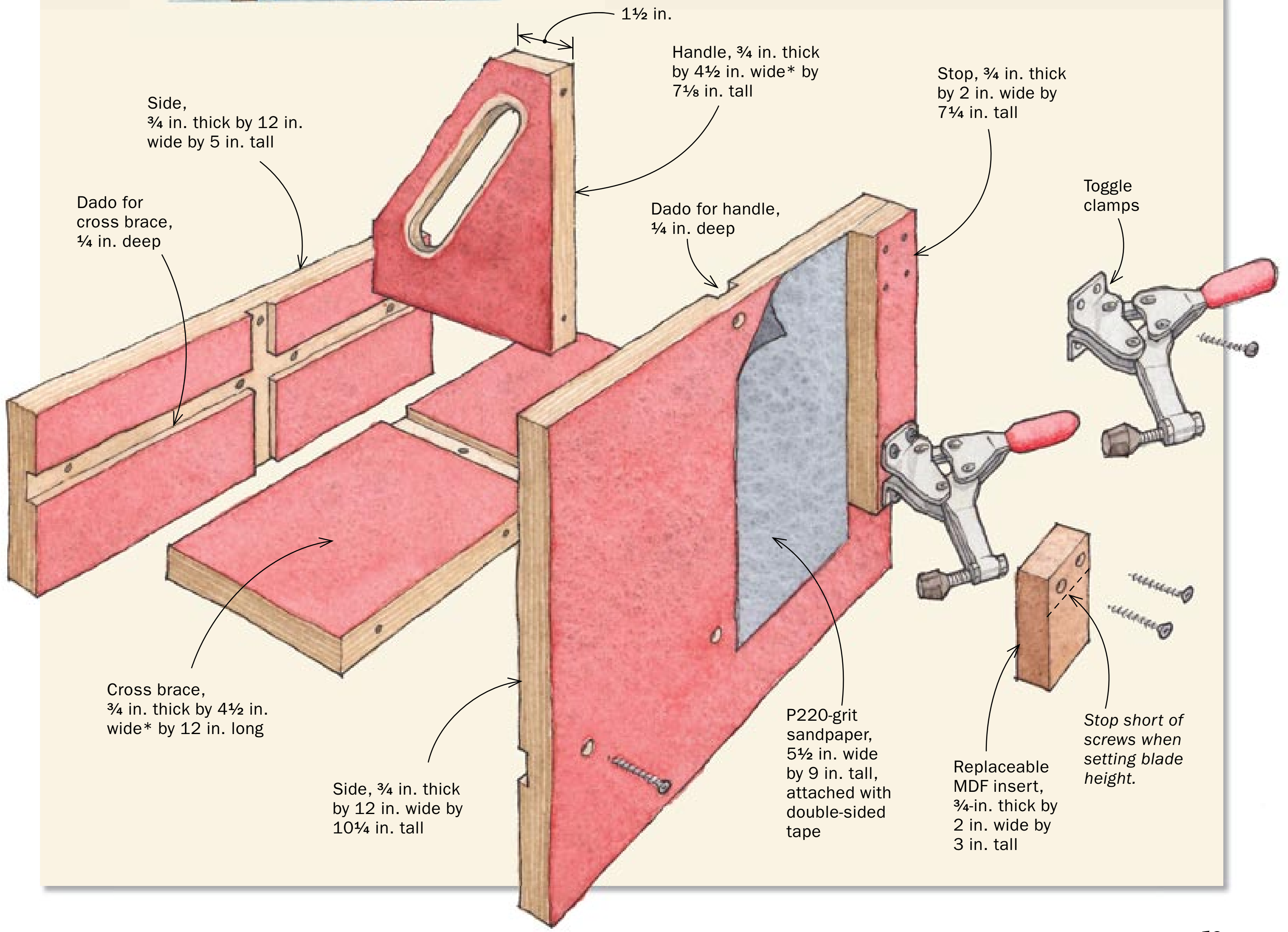
Using phenolic plywood as your main caul material will make gluing and

Make a phenolic tenoning jig

This stable, over-the-fence tenoning jig takes advantage of the slick nature of phenolic plywood as it carries the workpiece smoothly along the rip fence and through the blade. Toggle clamps on the vertical fence and sandpaper on the face grip the workpiece. Also, a replaceable MDF insert can be changed after too many saw cuts, and a user-friendly handle makes the jig easy to control.







Drawings: Jim Richey

FOR CLAMPING

The strong, nonstick plywood is a good material for clamping cauls of all kinds.

Glue doesn't stick to phenolic. *Use it for large veneering cauls (above). The multiple plies give it rigidity, and the ¾-in. thickness transfers pressure evenly. Just let glue dry, and then use a plastic scraper to pop it off (right).*

Also great for clamping pads. *Put scrap phenolic to use by cutting it into blocks for dent-free glue-ups.*

SOURCES OF PLYWOOD

www.andersonplywood.com (based in Culver City, Calif.)

www.robertsplywood.com (based in Deer Park, N.Y.)

www.woodcraft.com

www.whitecapdirect.com

www.mccauseylumber.com (based in Roseville, Mich.)

clamping cleaner and easier. You never have to worry about adhering a phenolic caul to your work. It's been years since I've had to tape or wax a caul, or wrap waxed paper around it.

When hand-clamping, ¾-in.-thick material is ideal because it's heavy enough to transfer pressure widely and evenly across the workpiece. I have sets of small, chamfered phenolic-plywood blocks ready to use for glue-ups or small repairs.

When veneering panels, whether in a vacuum bag or with clamps, the cauls are always slightly bigger then the panels. This overhang ensures that clamping pressure will be distributed across the surface of the veneer and substrate, but it also means glue can squeeze out onto at least the bottom caul. With phenolic plywood as the caul material, the dried glue will flake off with a paint scraper.

A colorful cabinetry option

Not limited to jigs and cauls, phenolic plywood can take its place at the design table. It's easy to imagine the sleek colors incorporated into modern furniture design and cabinetry.

It also is great for shop cabinets because it is prefinished, very simple to clean, and very durable. The edges can be faced or the plies left visible as part of an industrial or modern look. □

Stuart Lipp works at Steinway & Sons in New York City.

Add a Shelf to a Table

Four attractive ways to handle wood movement in a solid-wood shelf

BY PETER TURNER

I've made many tables over the years, and I often incorporate a wood shelf in the design. The shelf adds an extra layer of storage and more functionality, and it can be incorporated neatly into a night table, a hall table, or a coffee table.

Like a tabletop, a wood shelf moves with changes in humidity. And if you do not allow for that cross-grain movement in both the top and the shelf, the racking force of any expansion, when exerted on the legs, has the potential to cause the leg-to-apron joint to fail, or to damage the leg itself.

Because tabletops typically sit above the aprons and legs, movement can be controlled through the use of buttons or slotted screw holes (see "Attaching Tabletops," *FWW* #163). These methods hold the top fast to the aprons while allowing it to expand and contract freely. But the shelf is a challenge because you must accommodate the wood movement within a fixed space—between the legs.

I've made shelves that connect with the legs via tenons and shelves that rest on brackets. Another option, which I have seen in other furniture makers' work, is to screw the shelf to a table's stretchers; so I consulted two other makers for variations on that method. All of these solutions give the shelf freedom to move.

Peter Turner is a furniture maker in South Portland, Maine.

Solid-wood slab is tenoned into legs

A solid slab is the simplest form of table shelf, and it can be incorporated easily into most designs. When I use a solid-wood shelf, I orient it so the grain runs side to side and the movement is front to back. I attach it to the front legs with fixed tenons, and at the back, I use a loose tenon that floats in an elongated slot in the shelf.

The joinery is pretty easy to cut (see photos, facing page). On the shelf stock, mark out the front tenons and the shelf width. Next, make the inside shoulder cuts on the tablesaw. Clamp the shelf vertically in a crosscut sled, and use a stop block so you can make identical cuts on both sides of the shelf.

Cut away most of the waste behind the front tenons on the bandsaw, roughly defining the shelf width and reducing the waste for the stopped tablesaw cut that follows. For the tablesaw cut, you'll need a well-made crosscut sled. Clamp a stop block in place to align the cuts and ensure consistency on both sides of the shelf. Raising the blade higher than normal will allow you to get closer to the tenon shoulder, reducing the cleanup in the corner later. Be sure to watch closely so you don't cut into the tenon. Clean up the inside corner using chisels.

Next, use a handsaw to define the front shoulder of the tenon and then pare to the line with the grain to complete the tenon. While you're at it, lightly chamfer the tips of the tenons, which makes it easier to engage the tenon and mortise during assembly.

Now place the shelf on the legs to mark its top and bottom locations. As well, trace the tenon locations on the front legs.

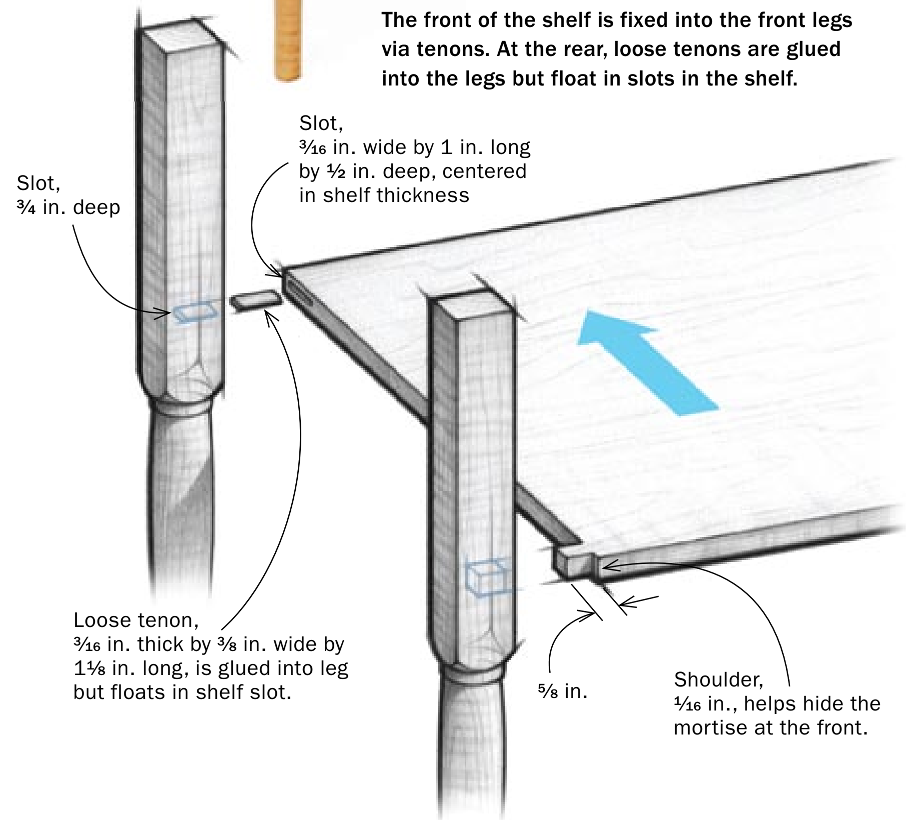
For the front mortises, I drill out most of the waste and pare to the line with chisels. To cut the slots in the rear legs and shelf, I use a Multi-Router. If you don't have a slot mortiser, use a router and a mortising jig to cut the slots.

When gluing up a table with this type of shelf, glue up the side aprons first. Then glue in the shelf at the same time you glue in the front and rear aprons.

A caution here: In thin shelves, there's not much meat above and below the slot. This method would be best used in designs that limit the weight and abuse the shelf must withstand. I do this by keeping the shelf close to the apron, maybe 4 in. to 5 in. away, and by keeping the shelf (and table) fairly small, say around 16 in. deep in 1/2-in.-thick material.

MOVEMENT DIRECTED TOWARD THE REAR

The front of the shelf is fixed into the front legs via tenons. At the rear, loose tenons are glued into the legs but float in slots in the shelf.



1 FIXED TENONS IN FRONT

Trim the shelf to form the tenons. *Rough out this long notch on the bandsaw. Then clean it up with a stopped cut using a crosscut sled on the tablesaw. Raise the blade high to reduce the amount of waste left near the tenon.*

Clean up the corner. *The stopped cut will leave a chunk of material on the inside corner, but it's easily pared away with careful chisel work.*

Cut the front shoulder. *After defining a 1/16-in. shoulder with a handsaw, pare to the line using a chisel.*

Lay out the mortises. *Mark the top edge of the shelf on all four legs. Place the shelf on a front and rear leg and mark the bottom of the shelf on the rear leg. Then mark the mortise for the tenon on the front leg.*

Cut the mortises for the front tenons. *Drill out most of the waste, then pare to the line with a chisel. Check the fit often.*

2 LOOSE TENONS IN BACK

Cut the slots. *Turner cuts the narrow slots in both the shelf and legs using a slot mortiser. You could do the same job with a router and mortising jig.*

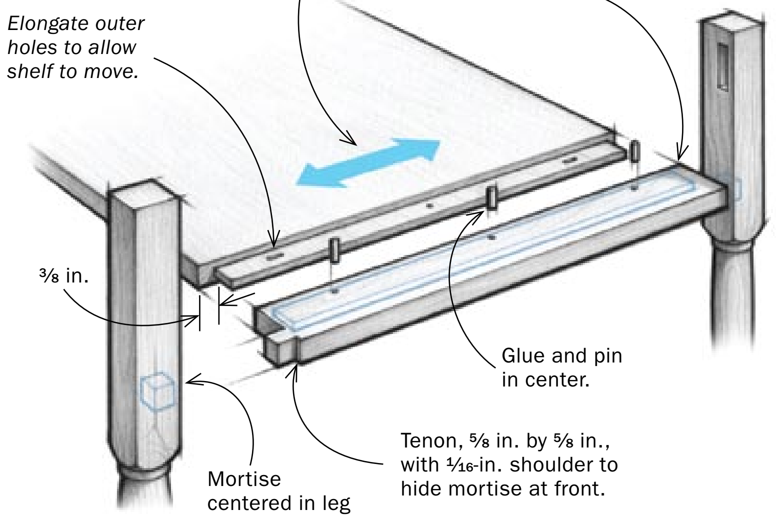
A perfect fit. *The loose tenon is glued into the leg but not the shelf.*

Photos, except where noted: Thomas McKenna; this page: Dennis Griggs; drawings: Christopher Mills

Breadboards keep shelf flat and control its movement

BREADBOARDS FILL TWO NEEDS

This design not only allows the shelf to expand and contract, but it also helps keep the shelf flat. Breadboards are recommended for larger tables, where movement may be more severe.



Breadboard ends are often used on tabletops to keep them flat and stable as the humidity level changes, and the design offers a straightforward method of attaching the shelf to the legs. A breadboard shelf looks best with a breadboard top.

The breadboards are cut 1¼ in. longer than the shelf width to allow for ⅝-in. tenons on both ends. Cut the ¼-in.-thick shelf tenon and the corresponding stopped grooves in the breadboards. Once you have a good fit, start working on the breadboard tenons.

Mark out the tenons on the ends of the breadboard and then cut the inside shoulder on the tablesaw. Next, cut to the shoulders, removing most of the waste on the bandsaw and finishing up on the tablesaw (see photos, below). Clean up the inside corner with a chisel, then carefully pare to the line on the front to finish up the shoulder there (see top right photos, p. 57).

To lay out the mortises on the legs, dry-assemble the shelf and breadboards and the front and rear leg-to-apron assemblies. Stand the shelf in place to mark the mortise locations on the legs. Drill out most of the mortise waste using a Forstner bit, and fine-tune the fit with chisels. This is painstaking work, but that's the fun part. If you prefer, you can create shoulders on all sides of the tenons, which will help to hide any gaps.

1 MAKE THE BREADBOARDS

Cut the groove for the shelf tenon. *The ¼-in.-wide by ½-in.-deep groove should stop 1¼ in. shy of the end at this point.*

Define the tenon on the tablesaw. *Cut the inside shoulders with the board held vertically (left) and then on edge (above), using a stop block to ensure consistency. Before making the second cut, remove most of the waste on the bandsaw so the offcut doesn't get jammed between the blade and the stop block.*

2 LAY OUT MORTISES CAREFULLY

Dry-assemble to lay out the mortises. *Mark the bottom of the shelf on the legs and clamp a long straightedge along those lines. Next, while holding the shelf vertically—registered against the straightedge—transfer the tenon locations to the legs.*

The right glue-up sequence. *You must assemble the long leg-to-apron joints first, install the side aprons and the shelf, then install the other legs and apron.*

Frame and panel: breadboard's cousin

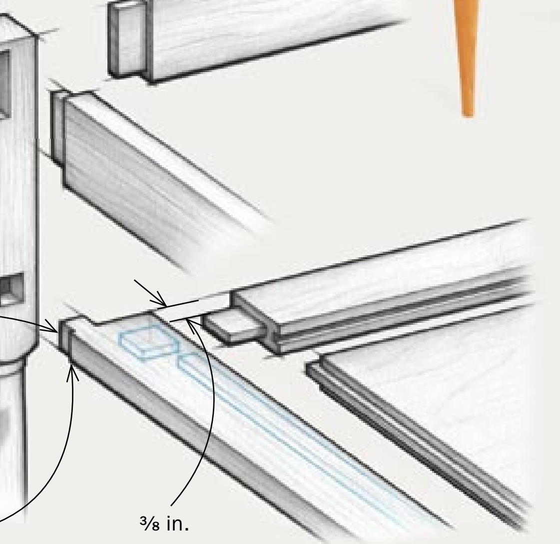
Another way to build a shelf is to use a frame-and-panel design. The frame accommodates the movement of the panel, and the construction makes for a sturdy shelf.

The panel is flush, top and bottom, within its frame. Like the breadboards, the short end stiles have integral tenons on their ends that are housed in mortises in each leg. Again, leave a 1⁄16-in. outer shoulder on the tenons to hide the mortise at the front of the legs. Although I haven't done it, you could use stub tenons to join the frame, instead of full-length tenons. The panel groove would serve as the mortise, so this method will save some time.

Of course, you do need to allow for movement where the solid panel meets the frame. Also, as with the breadboard example, during assembly you must glue the long sections of the table first.

FRAME AND PANEL CAN ELEVATE THE DESIGN

A frame-and-panel style shelf limits wood movement to the panel. It's a bit more work, but it creates a strong, stable shelf.



Photos (bottom left and right): Michael Pekovich; top left: Peter Macomber; facing page (bottom): Dennis Griggs

Brackets for circular shelves

When I made this table five years ago, my daughter Morrigan liked it so much that she named it Lucy. Lucy's circular shelf ruled out the use of breadboards and tenons. So I supported it by means of four small arms, or brackets. Each bracket has a tenon that joins it to its corresponding leg. Screws attach the shelf to the brackets. If the shelf were a clock face, with the grain running from 6 to 12, the arms at these points would hold the shelf fixed. The arms at 3 and 9 must accommodate seasonal movement, so their screw holes are slotted.

Begin by cutting the leg mortises for the brackets. Next, rip the bracket blank to width, but leave it long so you can cut the tenons on these small parts safely on the tablesaw. Check the fit of the tenons, then cut the brackets to length. Repeat for the other pair of brackets.

After tracing the bracket profile onto each blank, cut them out on the bandsaw and smooth the rough cuts on a spindle sander. Please be careful cutting and sanding these small parts. Finally, cut the recesses and slots in two of the brackets (see photos, right), and drill a countersunk hole for a screw in the other two.

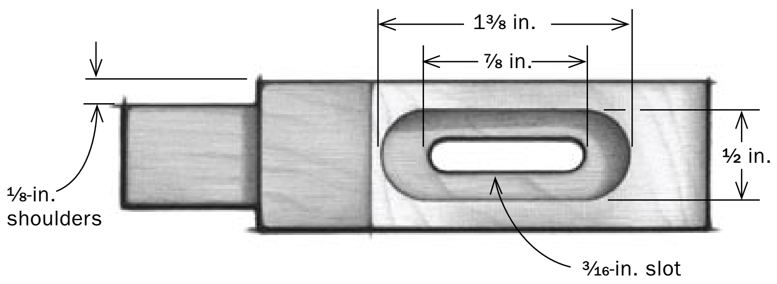
When assembling this irregular-shaped table, I needed to glue up the aprons and legs, install the brackets, then lay the shelf into place before installing the top.

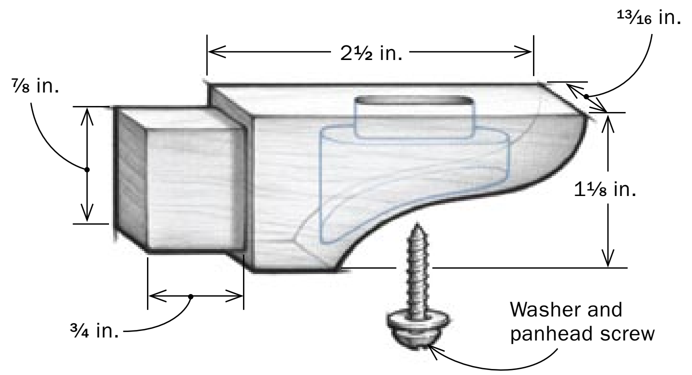
Trace the profile. *After cutting the tenons on the bracket blanks, trace the profile using a template and then cut it on the bandsaw.*

Slotted brackets get special treatment. *First use a ½-in. Forstner bit to hog out the wide area of the recess that will hold the washer (top left). Use a 3⁄16-in. bit to rough out the slot (bottom left). Finally, clean up both cuts with a chisel (right).*

SMALL BRACKETS CARRY A HEAVY LOAD

Turner used brackets to support the round shelf in this low table. One pair is slotted to allow movement (below and right); the other pair simply has one fixed screw.





Photos, this page (top left): Dennis Griggs; facing page: John DeGirolamo (top); Hank Gilpin (bottom)

Sit a shelf on stretchers

Like many pros, my woodworking training came on the job. So I'm never afraid to ask a friend for a solution when I have a question.

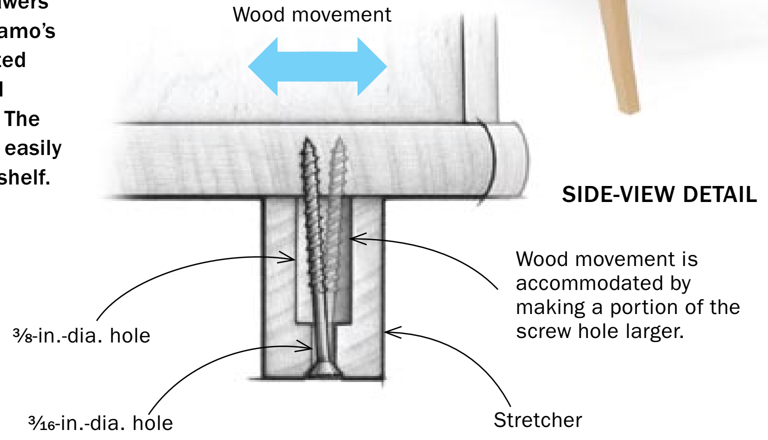
To bring more variety to this article, I consulted a couple of fellow furniture makers, John DeGirolamo (www.jovanni.com) and Hank Gilpin, to see how they install shelves in tables. Both offered examples in which the shelf is supported on stretchers.

For DeGirolamo's Emily side table (right), stretchers support a whole bank of drawers, adding a new design layer to the table. He uses the same approach with shelves. The drawer case is secured to the table with four countersunk screws that travel up through the stretchers and fasten into the box. John accommodates movement in the case by giving the last two-thirds of each screw some breathing room in an oversize hole.

Gilpin offered an end table (below) in curly hickory as an example of how to attach a shelf. The orientation of the small shelf makes predicting movement tricky. It helps that the shelf is small and will move relatively little. Just to be safe, Hank slightly enlarges each screw hole at the top of the stretcher. This way the shelf can move in any direction it wants.

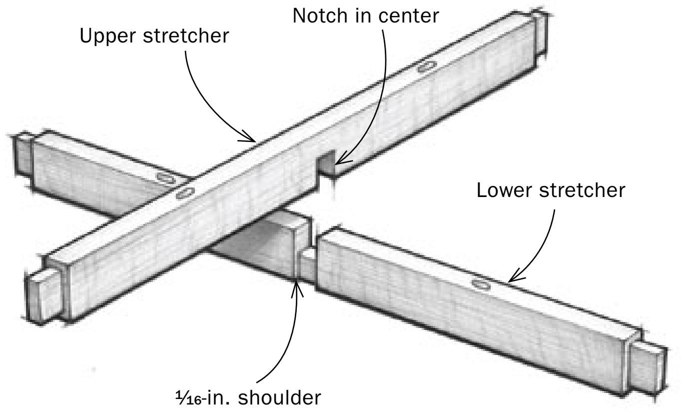
ADD A LOW BANK OF DRAWERS TO A TABLE

The bank of drawers in John DeGirolamo's table is supported by the front and rear stretchers. The arrangement is easily adaptable to a shelf.



NO-NONSENSE APPROACH TO MOVEMENT

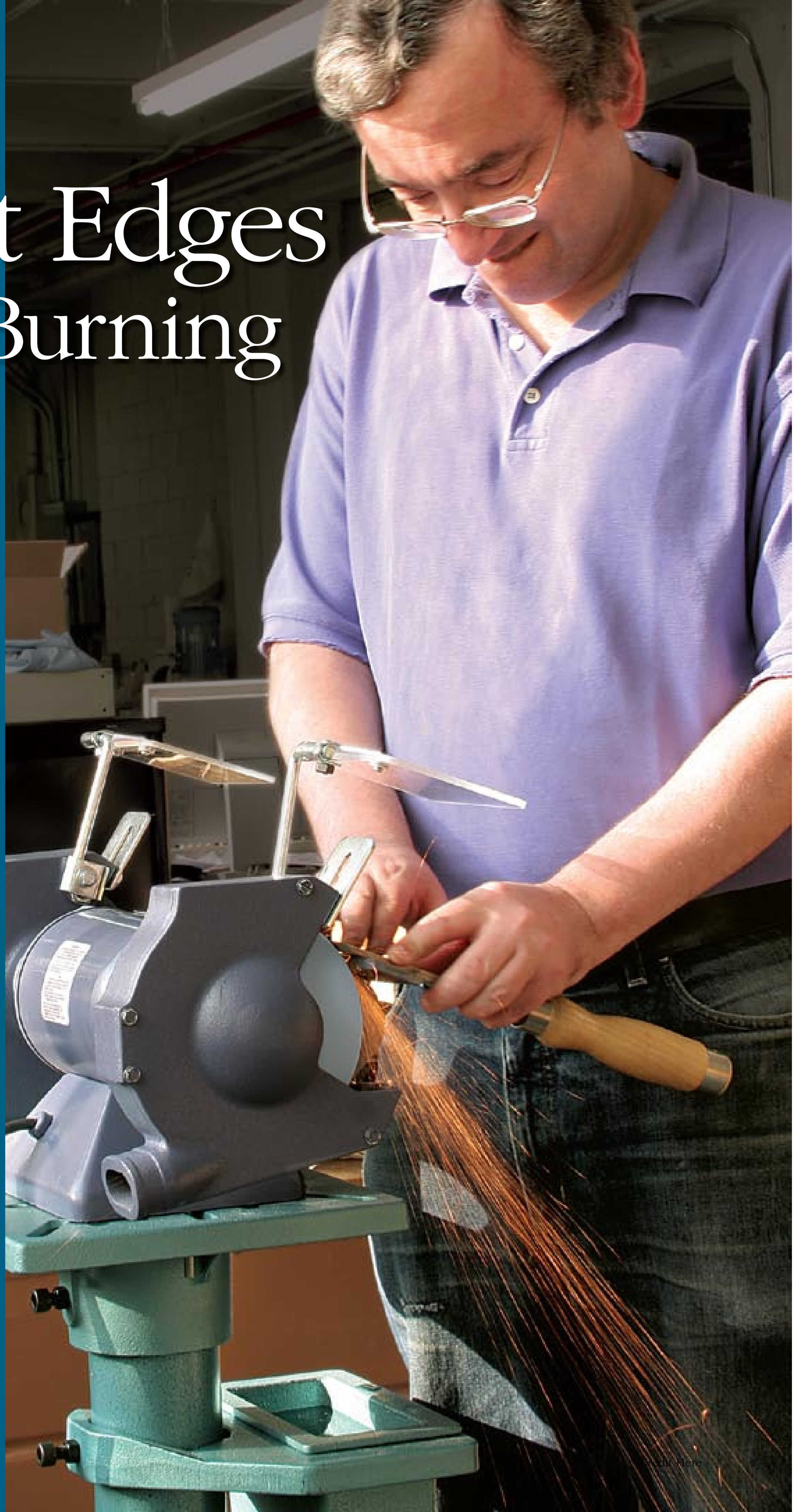
Hank Gilpin allows for movement in the shelf by elongating all the holes, simply by wiggling the drill bit. This way, the shelf can move in any direction.



Grind Perfect Edges Without Burning

In just seconds, get a tool ready for honing

BY JOEL MOSKOWITZ



When to grind

AFTER REPEATED HONING
As you continue to hone an edge, the flat area grows larger and soon you are laboring to hone almost the entire bevel with very fine abrasives. This is a waste of time, and wears your sharpening stones unnecessarily.

REPAIR DAMAGE
Grinding is also essential when a tool is damaged, with a deep nick or chip in the edge that honing can't handle, or a burned area.

CHANGE THE BEVEL ANGLE
Sometimes you'll need to change the geometry of an edge, creating a steeper or shallower bevel angle.

For years, I dreaded grinding a new edge on tools, and generally put off the task until the need was critical. I had trouble keeping the edge from burning, and the process was time-consuming. Consequently, most of my tools were in sad shape.

But two visitors to my shop changed all that. One was a friend from an abrasives company who made fun of my old gray grinding wheels and taught me a bit about wheel technology. After I had replaced my wheels with cooler-running, modern ones, my second visitor was Barry Iles of Ashley Iles Edge Tools. Barry has been forging and grinding edge tools since he was 14, and so I asked him to try out my much-improved wheels. First he took off my fancy tool holder, leaving only the basic tool rest. Then he turned on the grinder and dressed the wheel with a slight crown. About 10 seconds later, he handed me back a perfectly ground chisel.

It took Barry only five minutes to teach me his technique, and the rest was a little practice. I was amazed. Now I hollow-grind chisels, plane irons, and all other edge tools lightning-fast, easily, and without any trepidation. Here's how I do it.

Why a bench grinder?

Bear in mind that we are talking about grinding here, not honing. Grinding is done with rougher abrasives in order to quickly establish a fresh, clean bevel. Honing is done with much finer abrasives, to create a truly sharp edge.

Although there are many grinder options on the market, my own preference is for a basic 6-in. bench grinder, the high-speed, dry-wheel type that runs at about 3,600 rpm. "Slow-speed" bench grinders are OK, but you should realize that an 8-in. version will have close to the same surface speed as my 6-in. model, despite the higher rpm, and surface speed is what it's all about. Definitely do not buy a high-speed 8-in. grinder; it will burn tools for sure.

As for the benchtop wet grinders, they are simply too slow for my tastes and a lot more expensive than a dry grinder. I don't need all the fancy jigs either. For this technique, all you need is a solid, flat, adjustable rest. This can be the stock rest that came attached to the grinder, or an aftermarket rest that clamps to the bench.

Last, I'm not a big fan of flat grinders, such as sandpaper platters. They are expensive, and worse, they deliver a flat bevel. I prefer to do freehand honing, which is faster than using a honing jig, and a hollow bevel (from a round wheel) makes it easy to rock the tool on the sharpening stone to find and maintain the bevel angle.

Wheels that run cool

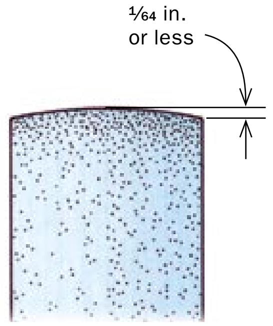
Almost all edge tools, except lathe tools, are made of tool steel that will lose its hardness if heated over 400°. This is known as burning, and when it happens the edge will first turn straw-colored (not bad), and then quickly blue (bad).

Wherever a tool touches the grinding wheel, particles of abrasive smash into the

Setup is critical

REPLACE THE WHEEL AND CROWN THE EDGE

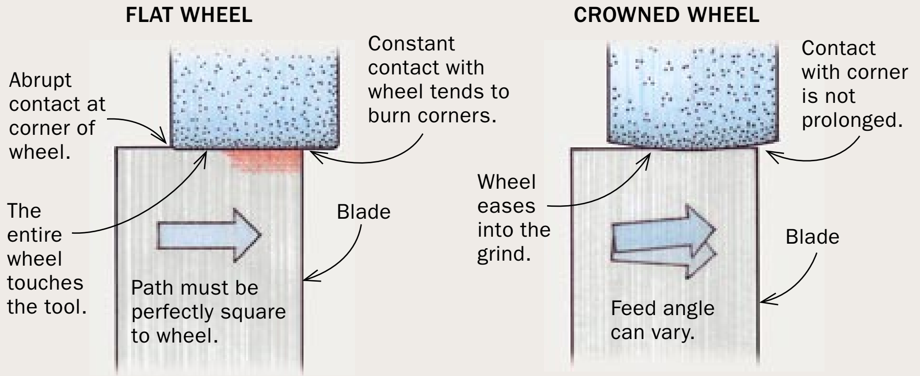
Moskowitz recommends a 60-grit Norton 3X blue grinding wheel, a high-grade "friable" wheel that runs very cool. And he uses a multi-point diamond dresser to maintain a slight belly on it, which is one of the keys to his grinding technique.



Dressing is easy. *Once the grinder is up to speed, lightly touch the dresser to the wheel, and its surface will clean up quickly. At the same time, contour the wheel to a very gentle crown.*

THE BENEFITS OF A CROWNED WHEEL

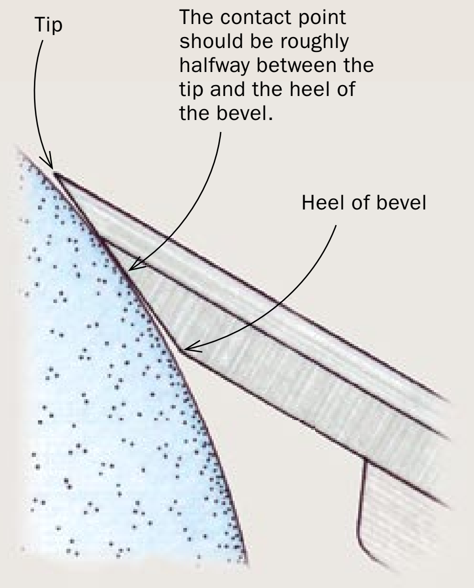
The crowned wheel ensures that you don't overgrind the corners, which are prone to burning, even if your side-to-side motion isn't completely square to the wheel. With the wheel dressed properly, you'll always know where you are grinding, and how heavily.



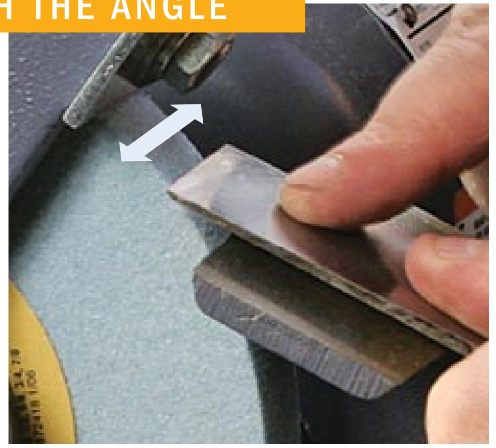
Touching up a bevel

The most common task is refreshing an existing bevel, where the overall bevel angle is fine but the honed area is just too large.

First, eyeball it. *With the grinder off, lay the chisel flat on the rest and see where the bevel touches the wheel. Adjust the tool rest so that the contact point is in the middle of the bevel (see drawing below).*



MATCH THE ANGLE



Then check the scratches. *With the grinder still off, hold the chisel against the tool rest and rub the bevel back and forth across the wheel (left). You'll know the tool rest is adjusted properly when the scratches are centered on the bevel (right). If the scratches are too hard to see, scribble on the bevel with a pencil, and scratch the steel again.*

tool and rip off anything in their path. The process generates lots of friction and heat, so much that the tiny particles of steel burst into flame in a shower of sparks. Most of the heat is lost in the sparks, but some of it goes into the tool (and wheel). That's where grinding goes wrong for most people. They don't know how to minimize that heat in the first place or manage it when it happens, and edges quickly turn blue.

Successful grinding starts with the wheel itself. The sharper the abrasive, the easier it will remove steel, and the less friction and heat it will generate. Unfortunately, like any cutting tool, the abrasive particles get dull. The solution? An abrasive wheel that either stays sharp indefinitely—impossible—or one that renews its abrasive surface. So abrasive companies have developed a binder—the stuff that holds the particles together—that weakens and breaks with heat and shock. As the abrasive grit in the wheel gets blunt, the impact increases, the heat builds, and the binder releases, exposing sharp, new abrasive grit. Wheels that shed their dull abrasive as they run are called "friable" wheels.

The first friable wheels were white aluminum oxide, but technology marches on, and Norton, for example, has introduced seeded-gel (SG) wheels under its 3X line. SG wheels use a ceramic abrasive particle that itself will fracture so you don't have to wait until the entire particle gets pulled away to expose a fresh edge.

The crown is the key

The right wheel is critical, but that won't guarantee cool grinding. The single most important thing Barry Iles taught me was to dress the wheel with a slight crown. There are several compelling reasons why.

With a flat grind, you can't predict where the blade will first touch the wheel unless you are perfectly square with the wheel (impossible to do freehand). Also, you can easily burn the corners of the edge as you are concentrating on grinding the center part. For reasons I'll cover shortly, the tip and the corners of the bevel are vulnerable to overheating and burning.

With the wheel crowned, however, it's easy to maintain control: Even when you approach the wheel out of square, you will ease onto the corner of the blade. And because I can easily control where I am grinding, I can take the pressure off the corners as I am grinding at the center.

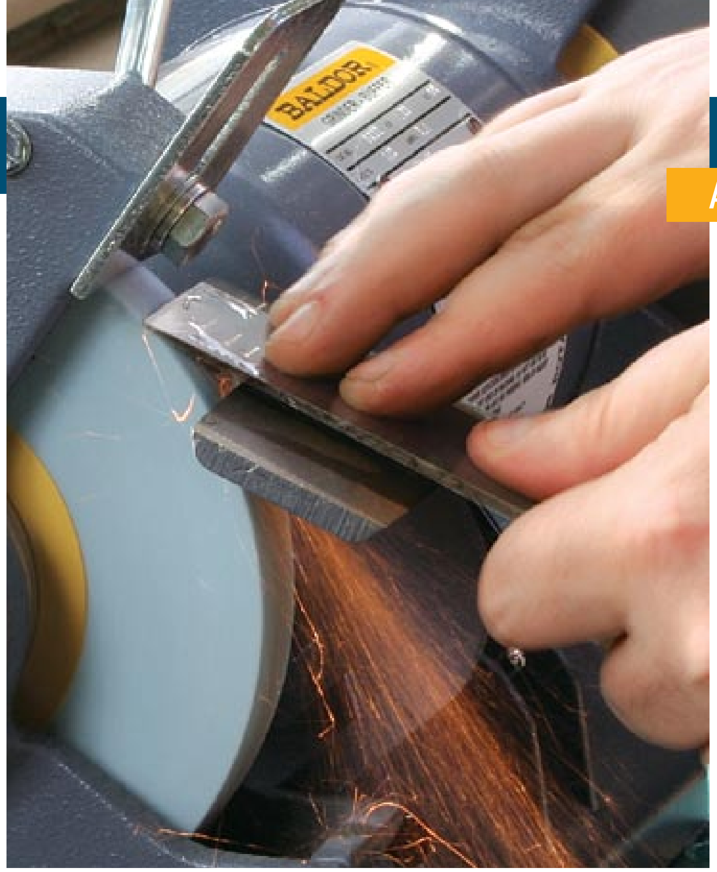
Also, a clean wheel cuts much cooler than a wheel clogged with steel particles and dull abrasive. Even friable wheels clog over time, so no matter what kind of wheel you use, you'll need to dress it. And a bellied, or crowned, wheel is critical to this technique, and the wheel dresser handles that, too. Dressing a wheel is easy, but make sure to wear safety goggles and a dust mask. Redress the grinding wheel whenever it seems to be cutting slower, when there is a gray accumulation of steel on it, or when the crown is flattened.

Another key to minimizing heat is to grind with a light touch. If you lean on the tool to try to speed things up, the abrasive can't cut it fast enough, the steel rubs, and the edge overheats quickly.

Your fingers are your heat sensors. Keep them only ½ in. or so from the edge, so you can feel the heat building. Put a full cup of water near the grinder. When the tool gets warm, dunk it into the water to cool it. One important rule is to first dunk the tool, then look at the edge being ground. If the tool is hot, the tip can burn in the time it takes to lift the tool and look at it.

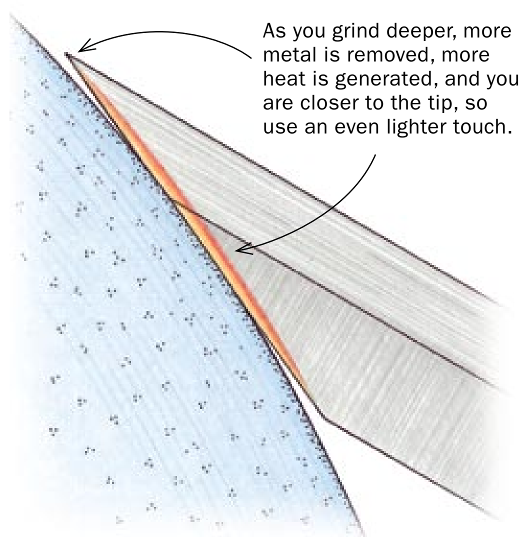
The last part of the puzzle is giving the heat a place to go. Here's the theory: If you grind a thick chunk of metal, the heat will dissipate safely, but if you grind a thin section, the heat remains concentrated and the metal burns. What this means in practice is that you should always start grinding away from the very tip (and the corners) so the heat can dissipate into the thick part of the tool. As the hollow deepens, you will reach the tip, but only at the very end of the process.

Photos: Kelly J. Dunton; drawings: Vince Babak

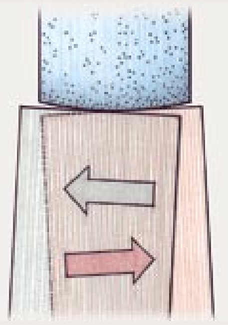


A COOL GRIND

Easy does it. *Use a light touch and keep your fingers close to the edge to feel the heat building up.*

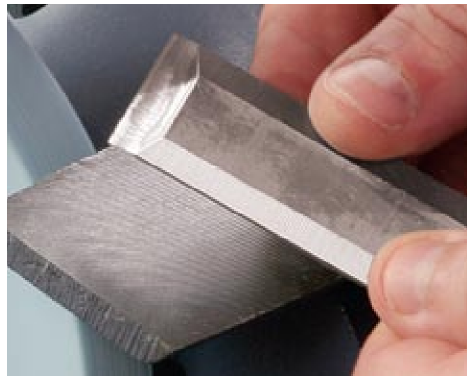


TIP



By skewing the blade slightly with each pass, you can avoid running its vulnerable corners into the hard corners of the wheel.

Dunk when you feel the heat. *The edge will heat faster as the new bevel gets closer to the tip. Have a can of cool water close at hand.*



Spot check along the way. *Keep a constant eye on the bevel as you grind. The widening hollow-grind should approach the edge evenly.*

Let's grind a chisel

Let's begin with the most common situation: a chisel or plane iron that has the right bevel angle but just needs a new hollow grind. It will be easier to practice on a thick bench chisel than a thinner plane blade, and a wider chisel will be easier to keep cool than a narrow one. I'll assume that the back of the chisel has been flattened already, at least near the edge.

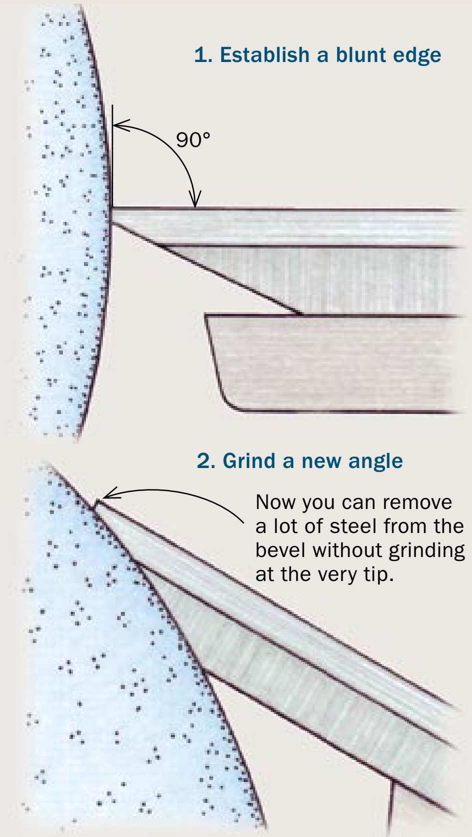
Use the existing bevel to set up the tool rest (see facing page). Before grinding, though, be sure to have a pot of water right near the grinder, and don your goggles. Place the blade flat on the rest and advance it lightly into the wheel. First just touch the tool to the wheel, remove the

The last pass. *The job is done when the grinding marks reach the edge. You'll know you're there when you feel a continuous, fine burr along the back. Stop right away to avoid overheating the tip. The edge is ready for honing.*

Grinding a new bevel

If a bevel is damaged or the angle is too shallow, you'll need to do some heavier grinding, and a new approach is needed.

TWO-STEP PROCESS



CREATE A THICK EDGE

Reset the tool rest. *Start by setting the tool rest square to the wheel. If you have a two-wheeled bench grinder, you can use the lower-grade wheel for this task.*

Lay out the new edge. *Use a square to mark a line for the tip of the new bevel.*

Grind to the line. *Use a light touch, dunk the tool often, and work back to the line.*

tool, and confirm that you are cutting at the center of the bevel.

The key is to let the wheel do the work. With steady, light pressure, move the tool across the slightly bellied center of the wheel. When you are just starting to grind, you are grinding in the middle of the bevel, and the heat will easily dissipate into the body of the tool. I stop a bit short of the corners of the bevel at this point, and I check my progress by looking at the hollow grind forming on the bevel. Since you aren't using any jigs, it is easy to pick the iron up and see where you are. I initially try to get an even grind, while staying about 1/64 in. from the corners. Then I finish the entire edge with light passes from corner to corner. As you get closer to a full hollow grind, the wheel will be grinding deeper and deeper into the tool (see the drawing on p. 65). This generates a lot more heat. Also, as you near the tip of the tool, the heat has no place to go. So slow down, use less pressure, dunk the tool more frequently, and keep using your fingers as a temperature gauge. Keep checking the bevel to see if you are removing material evenly. An even, light pressure, with a nice show of sparks, shows that the metal is being cut properly. Resist the temptation to rush near the end, and stop right away when the hollow-grind reaches the tip and a rough burr forms on the back.

Damaged edge needs heavier grinding

When a tool gets nicked or burned, the only way to repair the damage is to grind past the problem. The trick to this is first to set the grinder rest 90° to the wheel and grind a blunt, square edge. This gets you beyond the vulnerable tip quickly and into a thicker section. It also gives you a good reference surface for regrinding the bevel. Stop when you are well past the damage. Grind the blade as square (side to side) as you can, but don't sweat any minor inaccuracies. These will be removed in the honing process.

Now you'll have to reset the tool rest to the desired bevel angle. If there is not much of a bevel left at this point, use an iron already ground to the desired angle to set the tool rest, or use a wood or cardboard template as shown on the facing page. Of course, if you have two wheels on your grinder, you can square up on one wheel and maintain the bevel angle on the other tool rest. This time, check the squared edge of the tool to be sure you are grinding an even bevel. It is that simple.

Changing an angle: Shallower or steeper? If you need to change an existing bevel angle, the simplest situation is grinding a shallower angle (longer bevel). Here you will be grinding safely at the fattest part of the bevel, the heel. But if you need to make the bevel steeper, you'll first need to grind a blunt, square edge to the tool as when repairing damage. Otherwise you'll be doing some prolonged grinding at the tip, and you'll definitely overheat the metal. After putting a square grind on the tip, reset the rest to the new bevel angle and proceed.

Curved tools are a cinch

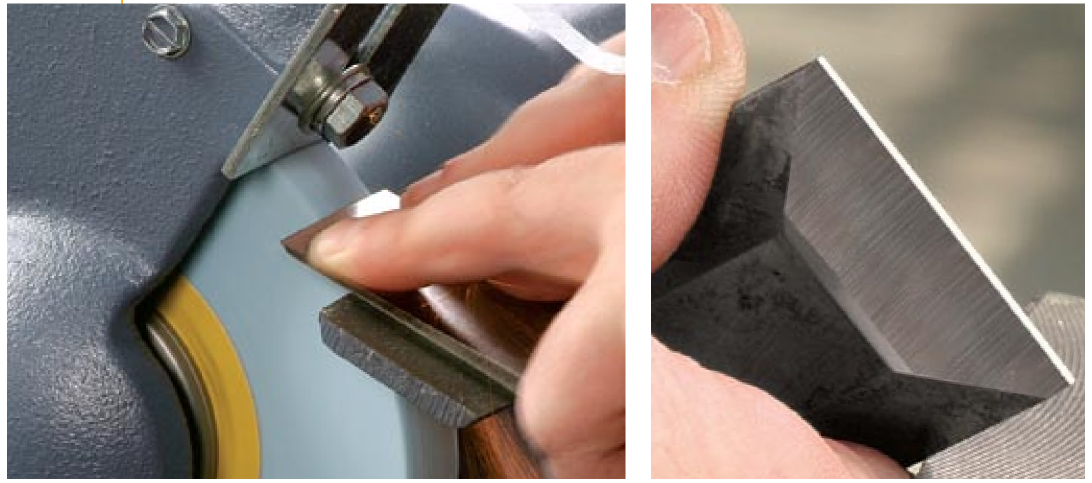
This technique of first grinding a square edge will help you grind an even bevel on curved tools, too, from a scrub-plane blade (see top right) to carving and turning gouges.

That's it. It's not brain surgery. There is no need for special jigs, no need for complicated setup. Practice helps, and with a tiny bit of mastery you will be able to do what craftsmen have been doing for centuries—walk up to a grinder, set it up in seconds, grind what's needed, and get back to work. □

Joel Moskowitz is a hand-tool retailer in Brooklyn, N.Y. (www.toolsforworkingwood.com). He recently began making tools under the Gramercy brand.

RESET THE REST AND GRIND THE BEVEL

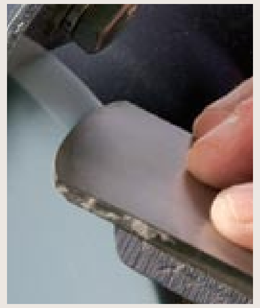
Reset the tool rest accurately. *One method is to use a tool already ground to the desired angle. If you don't have one handy, you can use a simple cardboard angle gauge as shown. Twenty-five degrees is a common angle for bench chisels and plane irons.*



The blunt edge is your guide. *If you keep an eye on that edge as you grind, you'll know you are removing material evenly on the bevel, and you'll have near-perfect results. Honing will take care of slight inaccuracies. You're done when the blunt edge disappears and you can feel a burr on the back.*

Curves are easy

Start square again. *For a scrub-plane iron, for example, simply lay out the desired edge profile, and then set the tool rest to 90° and grind to the line.*



Use the square edge as a guide. *Reset the tool rest to the bevel angle, and pivot the iron to follow the curve as you grind (left), using the blunt edge to track your progress (below).*

Ready for honing. *With a bit of practice, you'll be grinding smooth bevels in seconds, whether flat or curved.*

Undermount Drawer Slides

We test 9 models, and show how to use these invisible slides in all types of cabinetry

Appropriate for fine cabinets. *These invisible slides won't detract from the beauty of inset, dovetailed drawers.*

BY WILLIAM DUCKWORTH

I used to make cabinets for a living and have a vivid memory of one client in particular, an antiques dealer for whom I built a new kitchen. When she pulled out one of the drawers for the first time, she marveled at how smoothly it opened and closed—unlike the drawers in so many of her antiques. I felt a bit guilty for taking the credit; after all, it was the ball-bearing slides on those drawers that made them so easy to operate. That was 20 years ago, and the slides were the side-mount variety typical of the time.

Nowadays, you rarely see side-mounted slides. Most custom cabinetmakers and high-end manufacturers have switched to undermounts for all of their premium-quality kitchen, bath, and bedroom cabinetry, as well as built-ins, entertainment centers, and home-office furniture.

Undermount slides range in design and price from simple and inexpensive (as low as $5.25 a pair) to complex and pricey (as high as $47 a pair). While all models make opening and closing drawers easy, only the high-end versions have features worthy of fine furniture and cabinetry. For that reason, I limited the tests for this article to high-performing slides, comparing nine widely available models for price, ease of installation, and in-use features. Then I narrowed the pack to the five standouts shown at right.

I'll also present a series of installation tips for making a typical undermount slide work in almost any cabinet or case you build, with any type of drawer.

The pluses and minuses of undermount slides

One obvious reason for the popularity of undermount slides is that they're hidden from view. This is a bonus for furniture makers, who—let's face it—don't like to admit to using metal in their work. Still, I think the real selling point for undermount slides is the self-close and "soft"-close features that many now offer.

Both features involve mechanisms in the tracks that pull the drawer fully closed once it has been pushed most of the way in. All the slides tested have this

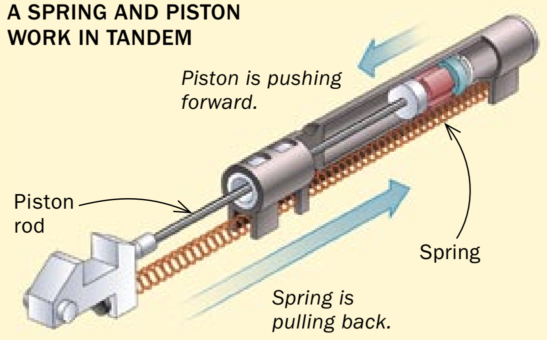
Photos: Charlie Reina; drawings: John Hartmann

The hardware

Wow factor

All of the undermounts we tested are self-closing, with a mechanism that pulls the drawer the last few inches. But six offer a soft-close feature, with tiny oil- or air-filled pistons that slow the drawer to a steady, mesmerizing crawl, no matter how hard it has been pushed. Say goodbye to loud thuds and rattling contents.

A SPRING AND PISTON WORK IN TANDEM



5 SLIDES WE LOVE

All nine undermount slides performed well, but five full-extension slides stood out for ease of installation and overall performance. Below each one is its quick-release clip, which attaches to the drawer box.

SOFT-CLOSE SLIDES

Accuride Eclipse Easy-Close
www.accuride.com
$47/pair (16-in. model)
Load rating: 100 lb.
Easy to install; quiet; built-in horizontal and vertical adjustment screws

Blum Tandem Blumotion
www.blum.com
$47/pair (15-in. model)
Load rating: 100 lb.
Quietest and smoothest soft-close mechanism; manufacturer offers templates for installation

Hettich Quadro IW Silent System
www.hettichamerica.com
$20/pair (15-in. model)
Load rating: 100 lb.
Very easy to install and adjust height of drawer; front fixing clips are plastic but sturdy

Knape & Vogt In-Line 9400 Series
www.knapeandvogt.com
$39/pair (16-in. model)
Load rating: 75 lb.
Fullest extension of all slides sampled; slide sizes match length of actual drawer box

SELF-CLOSE SLIDE

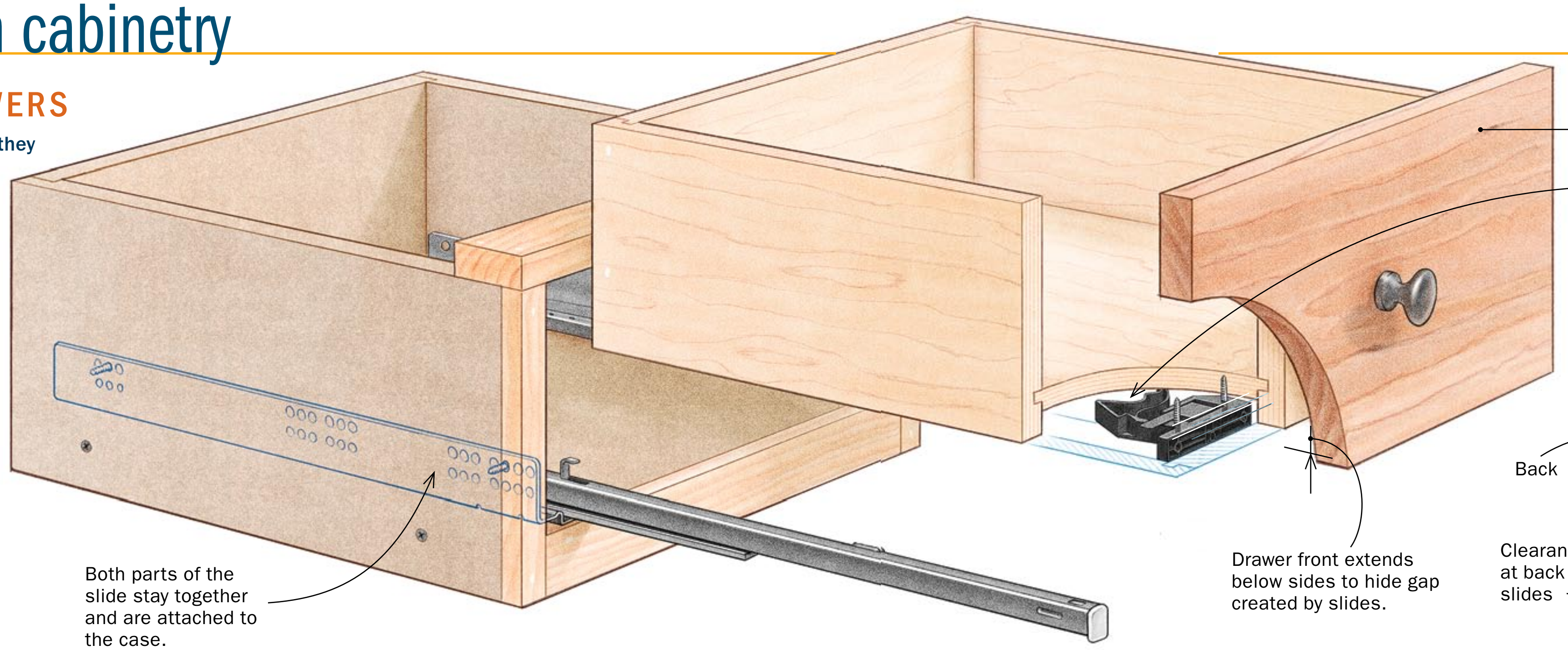
Accuride Eclipse Self-Close
www.accuride.com
$35/pair (16-in. model)
Load rating: 100 lb.
Easiest installation of self-close slides; somewhat noisy

Four other models were tested: the Grass Metro-Elite ($34/pair for 15½ in.); Hafele No. 423.57.641 ($38/pair for 16 in.); Hafele No. 421.14.940 ($9 pair for 16 in.); and Mepla Alfit Dynamic NT Series ($26/pair for 15 in.).

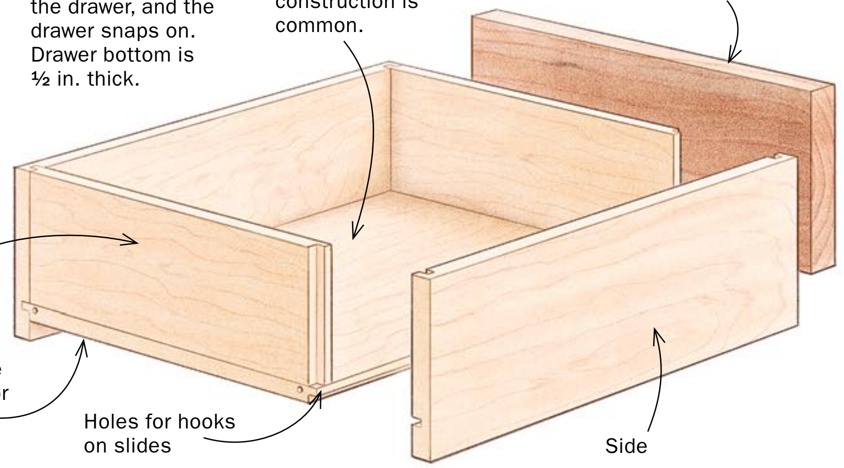
Designed for production cabinetry

APPLIED-FRONT OVERLAY DRAWERS

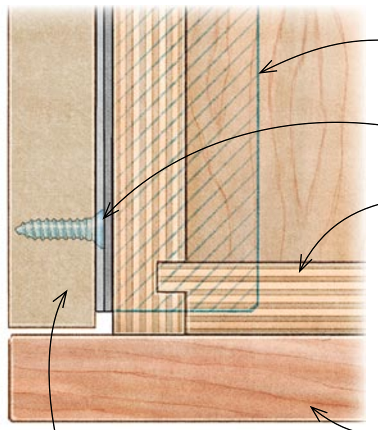
Undermount slides are designed for kitchen cabinets, so they are simple to install on overlay drawers with false drawer fronts, in both frameless and face-frame carcases.



DRAWER CONSTRUCTION



FRAMELESS CABINETS



Frameless installation is the easiest. *With no face frame extending into the cabinet opening, undermount slides are attached directly to the cabinet sides.*

feature. But six have the more impressive soft-close feature (see “Wow factor,” p. 69). Another advantage of the new line of undermounts is strength. I filled each drawer with heavy shop tools, and every slide easily carried more weight than its listed load rating.

On the downside, undermount slides use more space than side-mounts. Because they're attached beneath the drawer, you typically lose ½ in. or more of vertical storage space per drawer; with most undermounts, you also can lose space at the back of the drawer for the slides' rear-mounting clips. You can reclaim some space, though, by making the drawers about ½ in. wider than you would with side-mount slides.

Designs and sizes vary considerably

Many of the slides share key design features, such as interlocking steel channels that ride on ball bearings. However, the sizes and shapes of the slides vary widely, as do the mounting clips that fasten them under the drawers.

Like side-mounts, undermount slides come in a range of lengths, typically in 2-in. increments, from 12 in. to 30 in. Some also come in odd-numbered lengths, such as the 9-in., 15-in., and 21-in. slides offered by Blum. Several of the manufacturers represented here are European. Typically, the length of their slides is listed in both millimeters and inches.

The best of the best

Of the six soft-close slides I tested, four stood out: the Accuride Eclipse Easy-Close, the Blum Tandem Blumotion, the Hettich Quadro IW Silent System, and the Knape & Vogt In-Line 9400 Series. All of them are sturdy, well-made, easy to install, and quiet in use.

If price were no object, I'd go with the Accuride Eclipse, because it was the easiest to install and came with excellent instructions. Still, when I had to choose the slides for a new bedroom cabinet, I got the Hettich Quadros because they offer virtually all the benefits of the Accurides at a much lower price.

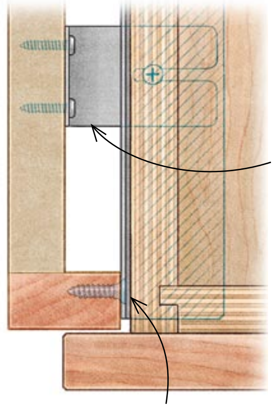
Of the three models without the soft-close feature, I'd go with the Accuride Eclipse Self-Close. Though somewhat noisy by comparison, it is by far the easiest to install.

Buy the slides, then make the cabinet

Virtually all of the better undermount slides work with any style of cabinet, framed or frameless. Most are made to be secured to the sides of a frameless cabinet carcase with flat-head screws through predrilled holes in the hardware. For use with face-framed cabinets, in which there's extra space between the drawers and cabinet sides, most of these slides also come with

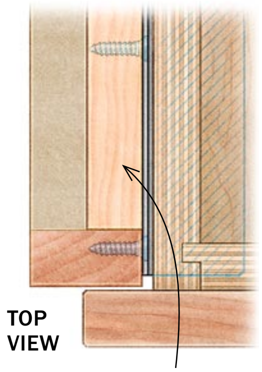
TWO OPTIONS FOR FACE FRAMES

BRACKETS ARE SUPPLIED



Space to fill. *Face-frame cabinets require extension brackets to bridge the distance between the drawer sides and cabinet sides and/or to attach the slides to the cabinet back.*

SHOPMADE SPACERS

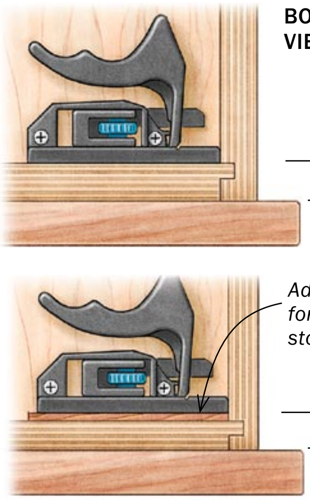


Block out the inside. *Simple strips of wood can be used to bring the cabinet walls in, flush with the inside of the face frame. Then the slides simply screw on, just like a frameless cabinet.*

Metal tabs grab the back. *Build the drawer as shown so the back doesn't extend below the drawer bottom. This allows the drawer box to sit on the slides, and the metal hooks to engage small holes drilled in the back (right).*

MOUNTING CLIPS ARE SIZED FOR ⅝-IN. MATERIAL

But spacers are supplied for ½-in.-thick drawer boxes.



Clips lock down the front. *The mounting clips are designed to be screwed onto the drawer with no measuring. Then the drawer is installed by pushing it onto the metal tabs at the back and clicking it down onto the slides.*

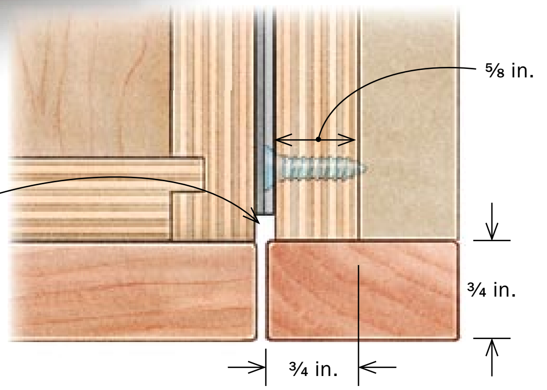
Beyond the basic install: inset drawers

It is easy to adapt undermount slides for use with fine furniture.

APPLIED-FRONT INSET DRAWER

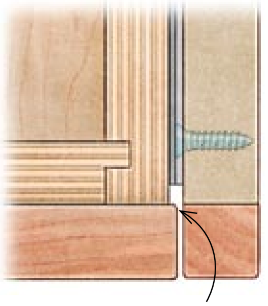
While an applied front thickens the drawer box and isn't appropriate in all situations, it makes it easier to adjust the gap around the drawer. Undermounts work well for this type of drawer, in both face-frame and frameless cabinets.

FOR FACE-FRAME CABINETS



Hide the slide. *Set the blocking in slightly from the inside edge of the face frame. This will create a finer gap around the drawer, hiding the slide bracket.*

FOR FRAMELESS CABINETS



Still hidden. *The concept is similar on frameless cabinets, but in this case it is the drawer front that hides the slide bracket and allows a fine gap.*

optional mounting brackets to secure them to the cabinet back. Or you can add filler strips or blocks along the sides, and mount the slides there. In either case, the front of each slide gets fastened with one or two screws into the inside edge of the face frame.

The length of the particular slide you choose, and how it attaches, will affect the depth of both the drawers and the cabinet. And, if you're planning a face-frame cabinet, you'll need a more substantial cabinet back than you would otherwise in order to mount the bracket for the back of the slide. So, if you're planning to use undermount slides, it's best to have the hardware in hand before you build the cabinet.

Making the drawers: notches or no notches?

In order to hide the hardware from view, most of these slides require that the drawer bottom be recessed ½ in. into the bottom of the drawer box. Also, if the drawer back is the same size, top to bottom, as the front and sides, most of the slides require you to notch out that ½-in. bottom lip of the back to accommodate the slide mechanisms, which have barbed hooks that lock the back of the drawer in place.

You can avoid that task if you build your drawer box as I did for the test samples. The bottom fits into ¼-in. grooves in the sides and front of the drawer. But the drawer back is cut short, and the bottom is fastened to the back from below (see p. 71).

Installation: a multitude of choices

As with the cabinets, all the undermount slides I sampled work with any style of drawer—inset, full or half-overlay, with or without an applied front—and with drawer sides either ½ in. or ⅝ in. thick. The particular drawer style you choose will determine how the slides are installed.

Applied fronts on overlay drawers are the standard—Given that most manufactured and custom cabinets use drawers fitted with separate applied fronts, most slide manufacturers provide mounting instructions based on that configuration. So, if you plan to build drawers with integral fronts (to which the drawer sides are attached directly), you'll have to recalculate the location of the slide within the cabinet, or the front-to-back size of the drawer, to make it work. In all cases, take great care to size the drawer properly, left to right, front to back, and top to bottom.

To illustrate the most likely situations for furniture makers, I built five sample cabinets and drawers.

Overlay drawers with applied fronts

In addition to being the industry standard, the overlay drawer with applied front is also the easiest application for undermount slides. In frameless cabinets, the slides are screwed directly to the cabinet, set back as per each brand's recommendations. The mounting clips are designed for ⅝-in.-thick drawer boxes. For ½-in.-thick drawer boxes, most manufacturers provide little plastic spacer blocks.

For overlay drawers in face-frame cabinets, the very front of each slide gets screwed into the edge of the face frame. To keep the slides parallel, you'll have to use the supplied side- or rear-mounting brackets, or add blocking to the sides of the cabinet.

Inset drawers with applied fronts

Inset drawers offer a fine-furniture look, and undermount slides will work great for them, given a couple of extra steps. The challenge is that the slide requires a gap of ⅛ in. or more between the drawer side and the mounting surface in the cabinet, so you'll have to make sure the shiny metal edge of the slide is not visible through the drawer gap.

For a typical face-frame cabinet, the best approach is to size the drawer so that the front edge of the hardware is buried behind the face frame. For a frameless cabinet, your best bet is to make the applied front slightly wider than the drawer box. This effectively hides the slide hardware behind the overlap, allowing you to maintain a fine gap around the drawer front.

Inset drawers with integral fronts

For top-quality furniture, in which the drawers have integral fronts and sides flush with the fronts (as in the half-blind-dovetailed sample shown), and with gaps around the drawer fronts that are less than 1/16 in., there's only one good way to install undermount slides. And it only works with face-frame construction. The thinner drawer front means the slides will be set too far forward, so far that they would be sandwiched between the edge of the face frame and the drawer, where they would be very visible sitting in a large gap. So you'll have to set the slides back a bit in order to tuck them behind the face frame. Do this by adding spacer blocks to the underside of the drawer.

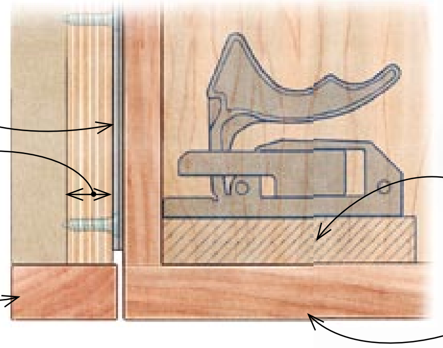
The remaining combination, inset drawers with integral fronts in a frameless carcase, is the least palatable option for undermount slides. Perhaps with that in mind, several of the manufacturers recommend against using undermount slides in this application. ☐

A former cabinetmaker and associate editor for Fine Woodworking, William Duckworth is a freelance writer in Connecticut.

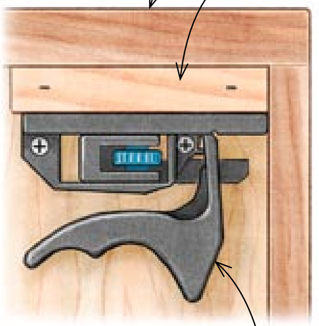
INTEGRAL-FRONT INSET DRAWER

Integral fronts are a hallmark of fine drawers. But a thinner drawer box puts the slide hardware too close to the outside of the cabinet. The solution on face-frame cabinets is to use spacer blocks to set back the mounting clips far enough to hide the slides behind the face frame.

FOR FACE-FRAME CABINETS



Set them back. *Glue and tack simple spacer blocks to the back of the drawer front, and then attach the mounting clips as usual.*



Hot-Rod Your Varnish

Fast-drying, wipe-on blend builds quickly for a durable finish

BY ROLAND JOHNSON

We'd all like a finish that can be applied easily by hand, stands up to the rigors of everyday use, and is easy to repair or renew. Several years ago, in my search for this Holy Grail finish, I started sampling varnishes. I rejected polyurethane because it's hard to repair and worse to remove if a piece needs a total refinish. I narrowed my search to alkyd-based varnishes, eventually choosing Pratt & Lambert's No. 38 clear. However, I wanted it to have more water resistance and to dry faster, and I wanted to wipe it on.

So I started tweaking the stock No. 38 and, through trial and error, came up with a brew that fulfilled my needs. I mixed equal parts of No. 38 and pure tung oil, added some pure spirits of gum turpentine, and zapped the mix with a dose of Japan drier.

This custom oil-varnish mixture has a number of advantages. It is easily wiped on and off with a paper towel. It can be wet-sanded into the grain to act as a pore filler. The thin coats dry quickly, reducing the opportunity for dust to get trapped in the wet finish. Often I apply finish in an area that is less than white-room clean, so eliminating the worry about dust is a real bonus. This finish is water-resistant and tough enough to hold up to everyday use, it's easy to repair or replace, it resists yellowing, and it dries hard enough to be rubbed out to a high-gloss sheen if desired. There

THE RECIPE:

5 parts	Pratt & Lambert No. 38 alkyd varnish
5 parts	Pure tung oil for water resistance
2 parts	Japan drier to speed drying time
2–3 parts	Pure gum spirits turpentine to make wiping easier

You can find a local retailer at www.prattandlambert.com. The other components can be found at hardware stores, paint stores, or home centers.

Mix and apply

Mix what you need. *Because this finish goes hard in the container after a few weeks, mix only what you'll need for each project.*

Pour it on. *Flood the surface with the first coat of finish, moving it around with a disposable brush or a paper towel.*

Look for an even sheen. *It is important to apply an even coat. Check your progress using a low-angle raking light.*

First coat also can fill the pores

If you want a glossy film finish on open-grained wood such as walnut, oak, or mahogany, you need to fill the pores. This gives the surface a more attractive, less plastic look.

Spread on the finish. *Liberally cover the surface with the oil/varnish mix. Using P400-grit paper, sand the surface with the grain to create a slurry that fills the pores.*

Remove the surplus. *Wipe the surface with a paper towel across the grain. The aim is to remove surplus slurry from the surface without pulling it out of the pores.*

Photos, except where noted: Mark Schofield; facing page: Roland Johnson

Sand and build

Dry enough to sand. *If the sandpaper produces a white powder (top), the finish is ready to sand between coats. If the sanding residue is brown and sticks to the paper (bottom), let the finish dry longer.*

Build the finish. *After sanding the first coat, vacuum the dust and then wipe on the next coat. Three or four coats are enough for most surfaces, but tabletops need at least six for sufficient protection.*

Picking your paper. *Johnson hand-sands between coats using a ¼ sheet of P400-grit paper, folded once.*

are a couple of drawbacks, though. It has a short shelf life (a few weeks before it starts to solidify), so mix only the amount you'll need for the project. More than with other oil-based finishes, cloths used with this mixture must be laid out to dry because the fast catalytic reaction caused by the Japan driers may create enough heat to spontaneously combust if they are left wadded up.

Flood on the first coat

A clear finish looks only as good as the wood beneath it, so good surface preparation is important. I typically sand to P240-grit, then use compressed air or a shop vacuum to clean off the dust, and wipe the surface with a tack rag before applying the first coat.

On horizontal surfaces, pour some finish onto the wood and use a disposable foam or bristle brush or a good-quality paper towel (Bounty works well) to cover the surface with varnish. On vertical areas, apply the finish with the brush. The key to success is an even coating. Keep applying finish until it is no longer absorbed quickly. Areas that absorb the finish will have a dull appearance. A raking light across the surface will help you see the dull spots.

You've applied an even film when the sheen across the entire piece is reasonably consistent. At that point, wipe off the excess with a dry paper towel or a lint-free cotton cloth and then allow the finish to dry thoroughly. If the temperature is at least 65°F, 24 hours should be enough time for this first coat.

A combination filler and finish—If you want a glossy film finish on open-pored wood, you will need to fill the pores. Spread on the first coat as above, and then sand the surface with P400-grit paper. The resulting slurry will form a paste that fills the pores. Lightly wipe the excess finish off the surface, going across the grain, and allow the finish to dry for 24 hours. To

Rub out and wax

Steel wool and wax quickly produce a medium-luster look.

Rub out with 0000 steel wool. *Rub the surface with the grain until you achieve a uniformly dull sheen.*

Bring up the shine. *Wipe on a coat of paste wax, wait 30 minutes, and then buff the surface with a cotton cloth to leave a silky surface with a medium luster.*

avoid pulling the filler out of the pores, don't sand the next one or two wiped-on coats.

Sand between coats and build the film, then rub out

I sand between each coat of finish with P400-grit paper. The real importance of sanding between coats is to even the surface tension of the next coat of finish. If the surface is left shiny, or with an inconsistent gloss, the wet finish will not flow out evenly.

The varnish is dry enough to sand when the sanding dust is white and doesn't gum up the paper: "When the swarf is white, the drying is right." If the dust is brown and forms tiny clumps on the paper, the finish isn't ready for sanding. Vacuum the dust.

After the first coat, where the wood absorbs a lot of finish and needs longer to dry, successive coats may be applied as quickly as every three or four hours, depending on the temperature and humidity. However, I wouldn't apply more than three coats in one day as you might trap solvent under the topcoat, resulting in a prolonged curing time. For most surfaces, three or four coats give a nice, even build. For tabletops or other surfaces likely to receive occasional liquid spills, I would apply a minimum of six coats.

I prefer medium-luster finishes, and to get there I use steel wool and wax. Unfold a pad of 0000 steel wool and lightly rub the surface. Keep checking the surface under a raking light until it shows an even dullness. At that point, vacuum away the steel-wool dust and rub on a thin coat of clear paste wax. Let this dry for 30 minutes and then buff the surface with a clean cotton cloth.

If you prefer a higher gloss, wait several weeks for the varnish to harden, then sand the surface with 600-grit (CAMI) paper, rub it with car polish, and finish with a coat of paste wax. Your piece will now have a finish worthy of your craftsmanship. □

Roland Johnson is a contributing editor.

Greatest Commission Ever?

Irion Company fills a house with 90 of the finest pieces of American period furniture

BY JONATHAN BINZEN

In 1999 Irion Company Furniture Makers, a highly regarded period shop in the rural town of Christiana, Pa., received a commission to furnish an enormous house with reproductions of the greatest American period furniture ever built.

The customer explained that he wanted to re-create the feeling he got when he saw the best furniture collections in museums. And he wanted no compromises along the way. No fudging of the dimensions, materials, construction, or detailing. Every piece should be built so it could stand beside its original like an identical twin.

In the nine years since, Irion has built and delivered 90 pieces for the job, which is now nearly finished. The roster so far includes four breakfronts, three secretaries, three high chests, 15 tables, four tall clocks, and over 30 chairs, and carries a total price tag of "probably over $2 million." One of the most impressive pieces, the nearly 11-ft.-tall, serpentine-front Holmes-Edwards bookcase, is featured on the back cover and in "How They Did It," p. 110.

Masterpieces in the making. *The craftsmen at Irion are a close-knit group, but they work independently, so each piece is built entirely by one person. The bombé chest-on-chest at left, a copy of one made in Boston by John Cogswell circa 1780, was built by Gerald Martin with carving by Steve Swann and Rob McCullough.*

Photos, except where noted: Jonathan Binzen

The client

"He didn't look like much," remembers Kendl Monn. "He came in wearing sweatpants and there were handprints in flour on the back. He'd been baking cookies that morning." But Kendl, who has 23 years' experience at Irion, 15 of them at the helm of the shop, and is deeply knowledgeable—and highly excitable—on the topic of American period furniture, soon realized that he was talking to a man whose passion for furniture might rival his own.

In that first conversation, the man in sweatpants—a financier named John who covets his anonymity—showed Kendl a picture of a chair in Albert Sack's *The New Fine Points of Furniture* and asked if Irion could make it. Kendl knew the chair well. A Thomas Affleck Chippendale-style dining chair with ball-and-claw feet, it had carving on its Gothic splat that merged right into carving on the crest rail, making it an extreme challenge to build.

Kendl recalls that when he gave an estimate of $5,000 for the chair, John asked him, "Why should I pay this much for a chair?" And Kendl told him, "I can't answer that question. I could show you other chairs nearly as good that would cost a lot less to make. But if you want that chair, all I can tell you is it's a fair price. And it's a great chair—any cabinetmaker would give his right arm to build one in his career." After thinking it over, John ordered 18.

Then he invited Kendl to see the newly completed house where the chairs would go. Sited on rolling land and built with foot-thick walls of local fieldstone and a cedar-shake roof, it had the flavor of a traditional Pennsylvania farmhouse—but at

Photos, this page: Kendl Monn

The commission began with this chair, *a reproduction of a Gothic Chippendale chair made by Thomas Affleck of Philadelphia. With carving on its pierced splat flowing onto the crest rail, it's a challenging chair to build. A craftsman could wait his whole career to make one, but Irion got an order for 18 to go with the New York Federal-style dining table shown below. Eric Jacobsen built the chairs and Jim Swift built the table.*

Like walking into a museum. _When the commission began, the client's house was practically empty. Nine years and some 90 reproductions later, the house is bursting with American masterpieces. The secretary above, a copy of one made in Salem, Mass., was built by Chris Arato. The Philadelphia lowboy and balloon-seat chairs at right were built by Kendl Monn._

35,000 square feet it was dozens of times larger. Inside, the woodwork approached the quality of fine furniture. In room after room there was floor-to-ceiling French walnut paneling, all mortise-and-tenoned and hand-scraped. There were coffered ceilings, secret doors, and hidden stairs. It had taken 12 years to build. John was camped out in a few rooms, but the great majority of the house, Kendl remembers, "was totally empty. Not a stick of furniture."

The story of the Irion commission is one of passion and patience. When they first discussed the job, John asked Kendl to shut Irion down for several years and dedicate the entire shop to his commission. When Kendl said he wouldn't do that to his many regular customers, John had another proposal: He would buy the business. Determined to keep craftsmen in control of the company, Kendl declined the offer without asking for a price. In the end, he agreed to devote a third of his workforce to John's commission for as long as it took. Kendl says, "He was amazingly patient. I think he appreciated the passion we have to really get the furniture right."

The Irion shop

Founded in 1947, Irion is spread out over the three floors of a century-old former hardware store, and it employs a dozen craftsmen. But it operates like a much smaller shop. Even the largest and most complex pieces were handled start to finish by an individual maker. A craftsman might get a hand along the way, and a few carvings were farmed out, but the responsibility for building the piece was his from drawings through delivery.

Most of Irion's craftsmen arrive on the job green and many stay for a decade or more. They learn the craft through years of building reproductions from start to finish, repairing fine antiques, and talking shop with antiques dealers, collectors, and museum curators. They deepen their knowledge by reading—the shop's collection of furniture books and auction catalogs is extensive—and also by traveling to museums, private collections, and auction previews to examine important pieces. Perhaps most important, they learn from each other.

The selection process

After laying out his plan to fill the house with furniture on a par with what he was seeing in museums, John asked Kendl to "get together for me all the information you can on the great masterpieces of American furniture." Kendl's first move was to collect the dozen or so books he consults frequently and flag the most impressive pieces in each. Then he spent several days at Winterthur collecting images of outstanding but unpublished pieces.

Winterthur, the museum and country estate with its unparalleled period rooms, is located in Delaware but not far from Irion,

Even the largest and most complex pieces for the commission were handled start to finish by an individual maker.

Wood great enough to rival the originals. _Irion craftsmen made sure the wood they used was up to the quality of the masterpieces they reproduced. They sawed their own mahogany crotch veneers for the drawers of the Salem chest-on-chest from around 1807, seen with Kendl Monn at left. Brad Ramsay made the reproduction. The Chippendale breakfront below, from an original made in Massachusetts, was built by Jim Swift._

Photos, this page (bottom) and facing page (bottom): Kendl Monn

Seeing the original piece in person was essential. *Jeff Williams, who built this copy of an 89-in.-long Charleston sideboard, visited the original at Yale University to be sure he got the details right. Seeing the fragile condition of the original gallery, which had been sawn from solid wood, he decided to strengthen the reproduction fretwork by making it from a crossgrain sandwich.*

and Kendl has spent countless hours there over the years. Kendl refers to the Winterthur library as "the furniture mecca of the world," and says, "I could spend the rest of my life there." In addition to books, catalogs, and account ledgers, the library has an enormous archive of black-and-white photographs documenting American decorative arts. The photos can be accessed by region and furniture type, so you can easily compare, say, a dozen Boston bombé chests or 20 Philadelphia tea tables. Focusing on furniture of the 18th and early 19th centuries, Kendl went through thousands of prints and compiled a thick packet of photocopies—several hundred pieces that he considered the best of the best.

To further immerse John in the world of American furniture, Kendl accompanied him on visits to the period rooms at Winterthur and to other furniture collections including New York's Metropolitan Museum and Philadelphia's Museum of Art.

When they began selecting pieces, some choices, Kendl says, "were no-brainers." Pieces like the Madame Pompadour high chest and the Affleck chest-on-chest were agreed upon immediately. Others took a bit of back-and-forth. John did a lot of research on his own, and if he came across a piece he particularly liked—a Newport kneehole desk, say—Kendl would either agree with the choice or present another kneehole that he thought was a bit better.

John was intent on having pieces representing a range of times and places—from William and Mary through Sheraton and from Massachusetts to South Carolina. But in order to get Kendl to consider furniture made far south of Philadelphia, John reports, "I had to drag him kicking and screaming." In the case of the Holmes-Edwards bookcase (back cover), Kendl was only convinced after John cajoled him into traveling to Charleston to see it in person.

Kendl stands firmly behind the selections he and John made, but doesn't claim that they are definitive. "There are a lot of masterpieces," he says, "and the choices often came down to what do you really like?"

Period tools for period pieces

John's insistence from the outset that there be no changes or shortcuts, that the pieces be exact replicas, not reinterpretations of the originals, matched Irion's long-established approach. Although the shop has an impressive machine room where stock is prepared and some parts are cut on shapers, the majority of the work on complex pieces like these is done at the bench with hand tools. Irion furniture is typically made with matched sets of boards, and all joinery and materials are appropriate to the period. Surfaces are finished with planes or scrapers. On the Holmes-Edwards bookcase, the veneers for the serpentine doors were sawn in the shop and adhered with hot hide glue. In many cases, complex moldings were created by hand with scratch stocks made for the purpose. And all the decorative banding and stringing was created and inlaid in the shop. In almost all cases the finish was shellac, sometimes tinted with aniline dyes and occasionally applied as French polish. Tops of tables and bureaus received lacquer or varnish topcoats.

Geography played a part in the selection. *Irion and its client sought the best pieces in a range of regional styles. This kneehole desk, built by Gerald Martin from an original attributed to John Townsend, is one of several pieces representing the Newport style.*

High fidelity, with a few exceptions

Irion followed original construction precisely, except in a handful of cases when to do so would be to court catastrophe. When Kendl and Jeff Williams examined the Charleston sideboard at Yale University, for example, they discovered that the sideboard's delicate fretwork gallery—which ran the length of the piece—was not metal, which they had thought possible, but solid wood. And the grain ran vertically, giving it no chance to expand and contract. Not surprisingly, the gallery was rife with cracks and extremely vulnerable to breakage. To avoid a similar fate on their version, they decided to glue up a three-ply blank that sandwiched a thin piece of veneer with its grain running the length of the gallery between two thicker pieces of wood with the grain running vertically.

To maintain fidelity to the originals, Kendl says, it was frequently necessary to make a tool. That might mean custom-grinding a scraper to re-create an unusual contour or filing the end of a nail to produce a stippling tool. The details on many reproductions these days are compromised, Kendl says, "because if the machine can't do it, they just forget it—or they change it."

Matching the original materials

The quality of the wood in period masterpieces—extremely wide boards with great color and figure—is one of the hardest things for the contemporary craftsman to match. Irion excels at it. The shop has access to extraordinary wood because it gets its supply directly from Lou Irion. The son of the Irion shop's founder, Lou ran the shop himself for many years before branching off into the lumber business in the early 1990s.

Almost every piece in the collection was built with boards hand selected by Lou and shipped down to his old company. For many of the pieces in the collection, Lou supplied mahogany from Peru. One notable exception is the Affleck chest-on-chest, which is one of John's favorite pieces. Irion's reproduction was built with veneers they sliced from 4-in.-thick boards of Cuban mahogany that are purported to have belonged to Thomas Affleck himself. Dredged from the Delaware River early in the 20th century, they were squirreled away in a barn for decades. Their owner, who considered them too special to use, died in 1998, having left instructions with his daughter to offer them to Irion. They found just the piece to use them in. □

Jonathan Binzen is a consulting editor.

Some pieces were "no-brainers." *The selection process was long and painstaking, but a few pieces rose to the top of the list immediately. Thomas Affleck's Philadelphia chest-on-chest from around 1770 was one of them. Gerald Martin built the reproduction, using wood dredged from the Delaware River and said to have belonged to Thomas Affleck himself. Kendl Monn carved the phoenix cartouche.*

WANT MORE?

• Go to FineWoodworking.com/extras to see the entire collection, and visit Knots, our online forum, to share your thoughts about the pieces chosen.

• Turn to the back cover for a close-up view of the Holmes-Edwards library bookcase reproduction, and go to p. 110 to learn how Jeff Williams created a full-size construction drawing of the piece.

Photos, this page (top left, bottom) and facing page: Kendl Monn

readers gallery

PHIL LOWE

Beverly, Mass.

Over the years, Lowe has had the opportunity to restore a number of original works by renowned Federalist architect and carver Samuel McIntire—waxing, polishing, and repairing them for exhibits. But this chair is a complete reproduction, one of six Lowe made for the Peabody Essex Museum's celebration of McIntire's 250th birthday. His six Santo Domingo mahogany chairs (16¾ in. deep by 21 in. wide by 34¾ in. tall), plus two originals, will sit together in the Peirce-Nichols House, a National Historic Landmark in Salem, Mass., designed by McIntire.

Working from one of the originals, Lowe made full-size drawings and spent about eight months constructing seven chairs (he made an extra as backup). Lowe says the challenges were the seamless arm-to-leg joinery and the tiny rosettes along the bottom back rail. The latter were so small (1⅛ in. sq.), he had to resort to magnification. The finish is antiqued shellac.

MATTHEW STARK

Santa Cruz, Calif.

Stark began woodworking at age 17, and 12 years later considers this Japanese step tansu to be a highlight of his career so far. Although he has built similar pieces while working for high-end furniture makers in large state-of-the-art shops, he made this piece on commission in his own small shop. The cherry and quilted maple tansu (finished with wipe-on polyurethane and wax) is 24 in. deep by 72 in. wide by 72 in. tall. The hand-forged pulls and handles are from Misugi Designs.

ED ZBIK

San Diego, Calif.

Zbik calls this ebonized walnut vase "Black on Black Dragon." The stylized dragon, known as Avanyu, is a common motif in North American Indian cultures, symbolizing rain or thunder. The piece, finished with Waterlox Original, is 7½ in. dia. by 7 in. tall.

JESSICA BEAUCHEMIN

Montreal, Que., Canada

Setting out to make a contemporary piece of furniture inspired by a classic style, Beauchemin decided on a "cocktail table," a typical piece of furniture from the Art Deco period. Finished with an oil-varnish blend, the woods are black walnut, sugar maple, Circassian walnut burl, and sycamore. The cabinet is 15¾ in. deep by 16 in. wide by 36 in. tall.

CHARLIE MOTT

Garberville, Calif.

When introduced to split-wood products, Mott was taken by the striking texture of the lumber but disappointed by the tool marks left from prying the wood apart. He now splits his own lumber by opening a crack and then using a heavy-lift air bag and a bicycle pump to separate the wood without marring it. This redwood door (2 in. thick by 36 in. wide by 80 in. tall) mixes a handplaned frame with split-wood panels. The tung-oil finish is applied only after the panels are burnished with a palm-fiber brush and buffed with leather, and any small splinters are pulled off with dental floss.

PHOTO: ROBIN ROBIN

Submissions

Readers Gallery provides design inspiration by showcasing the work of our readers. For consideration, send entry forms (available at www.finewoodworking.com) and photos (unaltered digital images, prints with negatives, or slides) to Readers Gallery, *Fine Woodworking*, 63 S. Main St., Newtown, CT 06470. If you want materials returned, you must include a self-addressed envelope with appropriate postage.

FRANK WOOLLEY
Ayer, Mass.

Woolley estimates he invested more than 1,500 hours making this bombé chest of drawers (21 in. deep by 38 in. wide by 32½ in. tall). About 570 hours went into the actual construction and 180 hours into the finishing. He spent the rest of the time researching the design, learning to make curved dovetails, and testing finishes. The primary wood is mahogany, with white pine, yellow poplar, and soft maple used for the interior parts. The top is finished with alkyd varnish and aniline dyes; the carving and moldings are finished with gel stain, and the rest of the surfaces are finished with shellac.

MARK PAULIN
Queensland, Australia

Paulin made this dragonfly wall cabinet (8 in. deep by 33 in. wide by 66 in. tall) over the course of four years. He used chisels to carve the dragonflies, and then layered three different colors of Humbrol paint on the abdomens. The carcase is Australian red cedar, and the hinges, knobs, and handles are made from tea tree. The finish is Estapol, an Australian varnish. Because of the weight of the cabinet, Paulin bolted it directly to the wall, hiding the hardware behind the interior drawers.

MIKE GREENBERG
Littleton, Mass.

Greenberg used this box (10 in. deep by 14 in. wide by 4½ in. tall) to explore grain direction and design. He resawed cherry and bird's-eye maple boards to achieve a continuous grain wrap around the box and a bookmatch on all the lids, interior and exterior. To move from a very rectilinear piece to one that creates a sense of movement, Greenberg coved the sides of the box and skewed the direction of the splines. The finish is Danish oil and wax. PHOTO: TOM O'MALLEY

TIM SWANBERG
Ovando, Mont.

Swanberg made this claro walnut cabinet for an avid guitarist. The open shelves are designed to store sheet music. To break up the cubbyhole effect, Swanberg staggered the drawers, which hold extra strings and a tuner, and added the apple-blossom marquetry. The box, 14 in. deep by 38 in. wide by 12 in. tall, tapers from bottom to top and front to back. The finish is shellac and wax.

MICHAEL LOBBY
Saint Helens, Ore.

Arts and Crafts design and Bhutanese architecture fueled Lobby's inspiration when he created this desk. He wanted the design to be uncomplicated yet highly functional as a writing desk and a workstation for his laptop. Finished with oil and shellac, the cherry desk has poplar drawer parts and ebony details. The desk is 30 in. deep by 58 in. wide by 31 in. tall.

CHRIS RAND
Berkshire, England

At 50, Rand decided to begin a new career as a custom-furniture maker and enrolled in the Furniture Design and Craftsmanship program at Buckinghamshire Chilterns University College (now Bucks New University). He built this tambour-door sideboard (16½ in. deep by 47¼ in. wide by 35½ in. tall) during his second and third years there. Inspiration came from the Arts and Crafts movement and the writings of James Krenov. The woods are chestnut, brown oak, and cedar of Lebanon, and the finish is Danish oil and wax. PHOTO: BUCKS NEW UNIVERSITY

Prevention is best cure for glue squeeze-out

Q: When making mortise-and-tenon joints, glue squeeze-out gives me trouble. If I wipe it off with a wet sponge, some of the glue gets into the wood pores and shows up under a finish. If I wait until the squeeze-out dries and scrape it off, I damage the surface. How can I avoid this problem?

—BARRY WISHENGRAD, Jamesville, N.Y.

A: THINK PREVENTION RATHER THAN CURE. The best way to deal with glue squeeze-out is to keep it from occurring. Here's how:

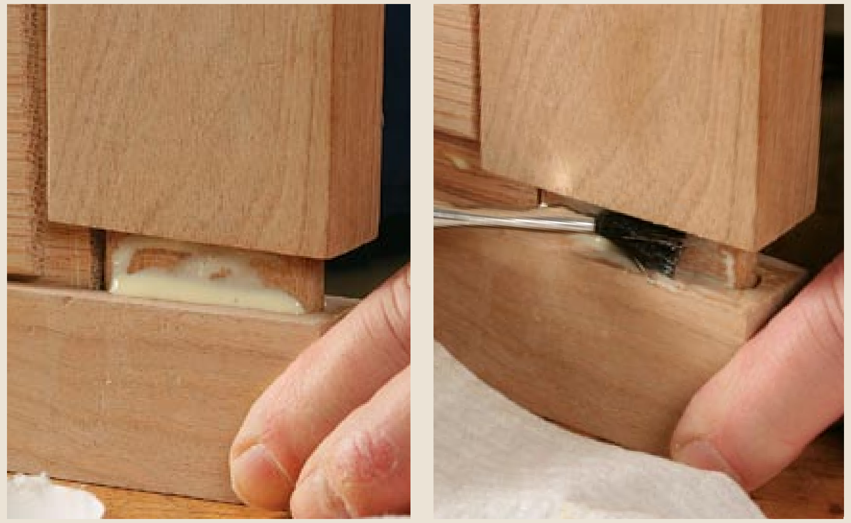
First, don't over-apply the glue. A thin coat on the mortise walls and tenon cheeks is all you need. There's no reason to apply glue to the end-grain surfaces, such as the tip or shoulders of the tenon, or their mating surfaces.

Second, remove excess glue as you are putting the joint together. When you insert the tenon into the mortise, stop two-thirds or three-quarters of the way home. You'll see a "roll" of glue on each cheek. That's the excess glue that would squeeze out if you pushed the joint all the way together.

Take a clean, dry glue brush and wipe away the glue roll, cleaning the brush on a rag between wipes. Now push the joint all the way home. If you do it right, there will be no squeeze-out at all, but there will be plenty of glue left in the joint, where it needs to be.

—Bob Van Dyke directs the Connecticut Valley School of Woodworking in Manchester, Conn.

Apply the glue. *Use a brush and apply it on face grain only—the mortise walls and the cheeks of the tenon.*


Remove the roll. *Insert the tenon partway into the mortise, until the glue forms a "roll" on the tenon cheek (left.) Remove this excess glue with a clean brush (right). Keep a paper towel close at hand to clean the brush.*

Clamp up a clean joint. *When the joint is clamped, there should be no glue squeeze-out.*

Ask a question

Do you have a question you'd like us to consider for the column? Send it to Q&A, *Fine Woodworking*, 63 S. Main St., Newtown, CT 06470, or email fwqa@taunton.com.

Photos: Staff

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You can refinish cabinets with water-based products

Q: Our eight-year-old kitchen cabinets need refinishing, and I would like to use a water-based finish. Is that a good choice? If so, can I apply it over the existing finish? (I'm not sure if that's water- or oil-based.) Or must I strip or sand down to the bare wood first?

—JACK HENZ, Temecula, Calif.

Arsenal of products. *Refinishing kitchen cabinets requires prep work including cleaning, sanding, and sealing.*

A: WATER-BASED WOOD FINISHES are being used increasingly to refinish kitchen cabinets. These products form clear, durable coatings, but proper surface preparation is vital.

Most water-based finishes won't adhere properly to a surface contaminated by grease or cooking oil. These must be neutralized and removed. Severe buildup requires the use of mild-pH degreasers such as Fantastik or 409. If you use naphtha or mineral spirits to remove the grease, follow it by wiping with denatured alcohol to remove the oily residue.

If the existing finish is damaged, peeling, or the wrong color, strip or sand it off completely. Otherwise, just give the surface a light sanding and remove the dust.

Now, apply a coat of dewaxed shellac as a barrier and bonding agent between the substrate and the topcoat(s).

—Jeff Weiss is president of Target Coatings Inc., in Rutherford, N.J.

Clean, sand, and seal. *Grease and grime will make a new finish problematic. Use a degreasing cleaner if the surface is very dirty, and scrub with paper towels or a Scotch-Brite pad (top). If the old finish isn't peeling, just give the surface a light sanding (middle). Apply a coat of shellac (bottom) to seal in any residual grease and to give a firm base for the water-based topcoats.*

Dealing with sappy Spanish cedar

Q: I have a humidor that I built and lined with Spanish cedar. The trouble is, the cedar leaks sap, which then collects on the cigar boxes. Every six months, I remove the sap with acetone and resand the cedar, but the sap always returns. What can I do?

—JOHN VANCE, Kirkland, Wash.

A: UNFORTUNATELY, THERE'S NO GOOD WAY to draw the sap out of Spanish cedar. Replacing the lining in your humidor with clean pieces of cedar is the best option. Just be very picky when you buy it. If it's not bleeding in the lumberyard, you shouldn't have a problem later.

If the current lining must stay, there are a couple of ways to deal with the problem. As you've found, wiping the sap away with acetone lasts only so long. Heating the cedar, such as with a heat gun, may draw some of the sap out but won't get all of it.

The simplest solution is to seal the humidor's interior with shellac. However, while that will end the sap problem, it will also eliminate the cedar's mild, spicy aroma and reduce its ability to help regulate the humidity level.

—Strother Purdy is a former associate editor at Fine Woodworking.

Spots that stick. *Sap is the bane of Spanish cedar, used as an aromatic lining in better humidors. The sap is sticky and so persistent that you just might have to live with it.*

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Invisible fix for chipped plywood

Q: While planing the solid-wood edge-banding on a plywood tabletop, I accidentally planed through the veneer, leaving a small but unsightly nick. Can I repair this without having to remake the top?

—MICHAEL CROUSE, New Freedom, Pa.

Now you see it. *A nick mars this plywood top, a result of planing the solid-wood edge-banding that abuts it.*

A: YES, YOU CAN. Start by planing fairly thin shavings (0.003 in. to 0.004 in.) from a piece of scrapwood of the same species, color, and grain pattern as the plywood. Trim a dozen or so shavings somewhat longer than the bare spot. Dab a thin layer of yellow glue onto the bare spot and place one shaving on it.

Repeat this procedure until you've filled the void and then some—seven to 10 layers. Work quickly in order to finish before the glue dries. Place a business card or a piece of waxed paper on top of the mound and immediately clamp a hardwood block over the repair. A second block underneath the workpiece will prevent denting.

Tighten the clamp to force the wood shavings to conform to the irregular surface. Let the repair dry overnight before removing the clamp and blocks. Now, carefully handplane the mound with a sharp, standard-angle block plane. As you get close to the surrounding surface, switch to a scraper and/or sandpaper for better control. (For an open-grained species like oak, I also put in fake grain lines with an awl to match the surrounding wood.)

Fill and conceal. *Glue thin shavings from matching wood to fill the nick (above). Once the glue dries, the patch is planed, scraped, and sanded. With a finish applied, neither the nick nor the patch is visible (left).*

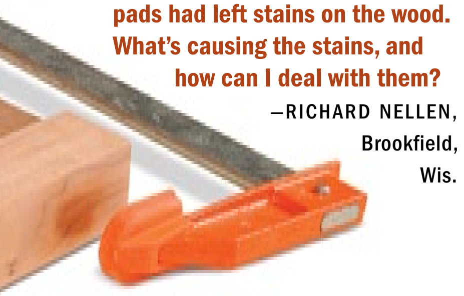
Because of the high wood content and the thin glue bond between layers, the repair holds up and takes stain beautifully.

—Hendrik Varju makes furniture near Acton, Ont., Canada.

How to eliminate clamp stains

Q: I recently did a glue-up that required more clamping pressure than usual. I used Jorgensen clamps with soft-plastic pads. When I removed the clamps, the pads had left stains on the wood. What's causing the stains, and how can I deal with them?

—RICHARD NELLEN, Brookfield, Wis.



Clamp stains. *Under extreme pressure, the soft plastic pads on some clamps can leave stains.*

A: YOU'RE ENCOUNTERING OIL STAINS. Adjustable Clamp Co., which makes Jorgensen clamps, uses a softer plastic for its accessory pads than many other companies. Under heavy clamping pressure, the plastic can exude a bit of oil, which taints the wood.

If extreme pressure is required for the job at hand, you can head off the staining problem by replacing the plastic pads with sacrificial wood pads. I use yellow glue to attach pads made from ¼-in. plywood scraps to my Jorgensen clamps. The glue holds the pads in place but releases them under a firm tap from a hammer when the pads need replacing.

If you need to remove clamp-pad stains from existing workpieces, lightly sand the affected areas or wipe them with mineral spirits or naphtha. Either one should do the trick.

—Roland Johnson is a contributing editor.

Make your own pads. *To avoid clamp stains, replace the plastic pads with sacrificial pads made from ¼-in. plywood.*

Glue up curved slabs in one shot

BY DAVID J. MARKS

About 20 years ago, I received a commission to build a 6-ft.-long dining table with an elliptical glass top. The glass was quite heavy and required a solid base. To challenge myself, I decided to come up with a design that ventured away from the predictable four-legged footprint.

After drawing a number of sketches, I decided on a knockdown design of two coopered uprights connected by a pair of stretchers. I had built previous coopered pieces, gluing the staves in pairs and then gluing the pairs to each other until I had a completed piece. However, the curves of these uprights each consisted of 14 staves. That's a lot of pairs to glue up.

Fortunately, I had taken classes with renowned furniture maker Garry Knox Bennett at his studio in Oakland, Calif. Bennett had demonstrated a cable-clamping jig that he had built, and although I could not remember exactly how he built it, the concept remained with me and I came up with my own jig.

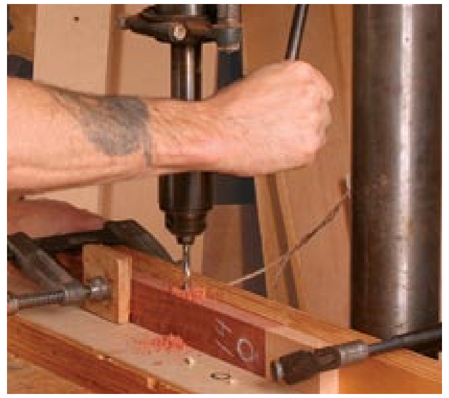
The principle behind a cable clamp

Aside from pure speed, the main advantage of this jig is its flexibility: It can be used to clamp curves of almost any radii, asymmetric curves, even S-shaped curves, all without any modification to the jig. It can be used for clamping any portion of a curved form, but not a full circle like a column, which is more efficiently pulled together with an external system such as a band clamp.

The jig consists of a rectangular wooden frame that houses three long pieces of all-thread steel rod. The rods are connected to steel cables fed through holes in the staves. When all the staves have been glued, the steel rods are drawn back using a socket chucked into an electric drill. The rods pull the cables, which in turn draw the staves together, keeping them aligned.

Lay out and drill the staves

Matching staves. *If the staves come from more than one board, spend time getting the best color sequence. Number the staves and mark them with a carpenter's triangle.*



Precision drilling. *It is critical that each set of holes line up across the staves, so drill the pieces before beveling them. Use a drill press with a fence and a stop block.*

Drill holes before beveling staves

After the staves have been ripped to approximate width, in this case 2 in., bore the holes for the cables. It is critical that all three sets of holes be in alignment: I use a drill press with an adjustable fence bolted to the table to ensure that the holes are centered; a stop-block clamped to the fence ensures that all of the holes are indexed from one end of the staves.

The diameter of the holes is ¼ in. to allow for polypropylene tubing. The tubing stops glue from sticking to the cable, which could prevent it from being removed after the glue has set. Because the tubing stretches when pulled, it breaks free from the glue.

With the holes drilled, the staves can be beveled. If the curve was a section of a circle and all of the staves were exactly the same width, then you could mathematically come up with a consistent bevel angle for all of the staves. However, I find that I can form a more pleasing curve by taking a thin strip of wood and bending it. I draw this curve full-scale onto a piece of plywood or medium-density fiberboard (MDF) and then cut out the shape. I then use

Photos, except where noted: Mark Schofield; this page (top): Don Russel

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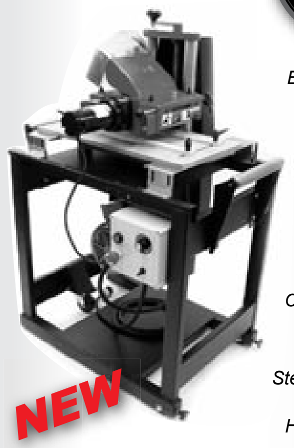

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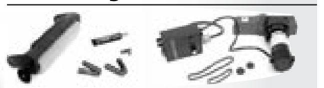

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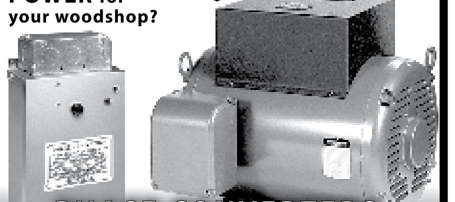
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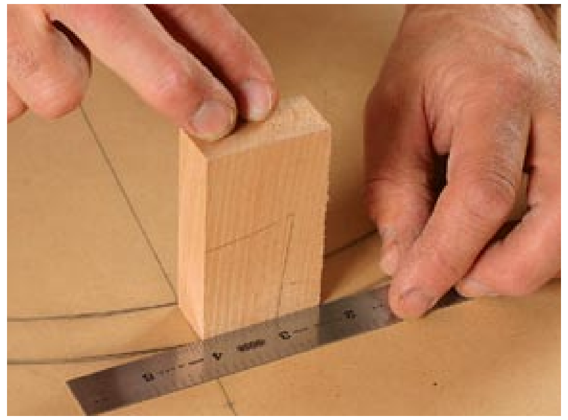
Align and bevel the staves to fit the template

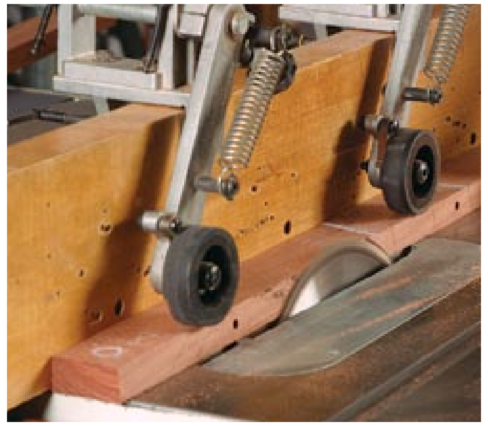
The right curve. *After creating a pleasing curve and cutting it on a template, transfer the curve to a piece of plywood or MDF and mark the centerline.*



Work from the center outward. *Use a sample block in place of the unwieldy stave to discover its correct location at the center of the curve. The center of the block should just touch the outside line. Mark this line using a ruler.*

Mark the line. *Remove the sample block and draw a short line against the edge of the ruler.*

Calculate the angle. *With the base of a protractor on the pencil line just drawn, swing the arm until it bisects the curve on the centerline and record the angle.*

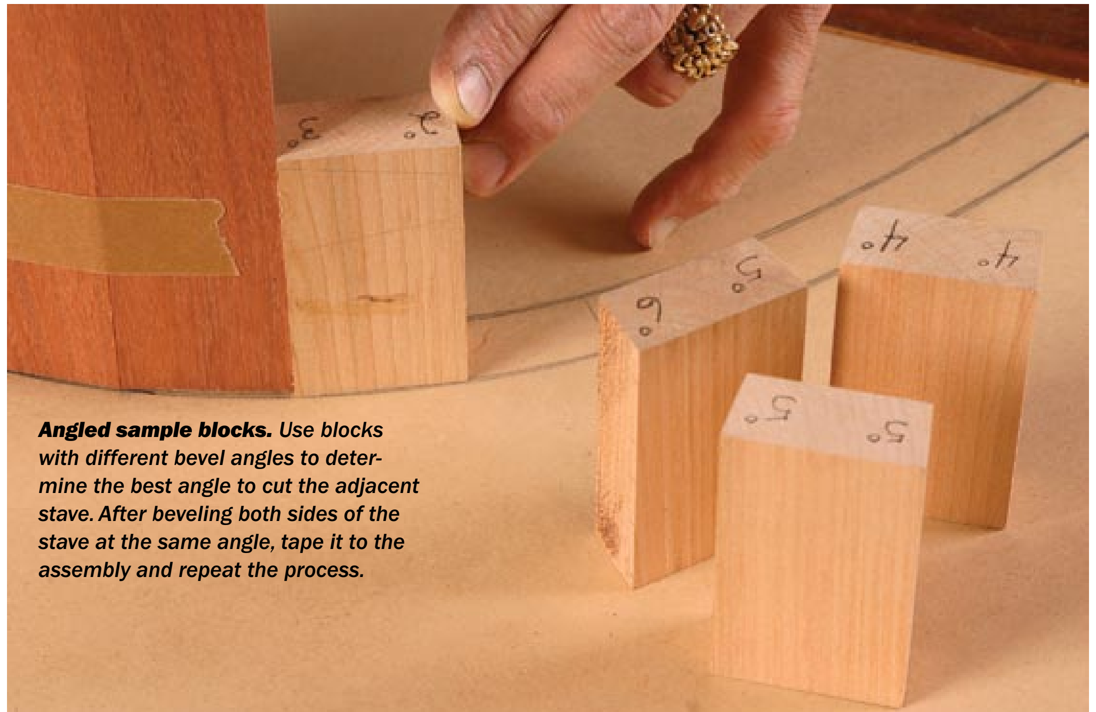


Bevel the stave. *Set the blade to the angle recorded by the protractor and bevel both sides of each stave to the same angle.*

Align the center staves. *Tape together the two beveled center staves and place them on the template.*

this template to draw the curve onto a piece of MDF. By flipping the template, I can check that the curve is symmetrical. Rather than trying to balance a tall stave on the MDF, I cut a series of 3-in.-long scrap pieces the same width and thickness as the stave. Then I bevel their edges at a variety of angles, using the drawing to anticipate the angles I'll need.

Center a block between the inner and outer lines of the curve with one side against the centerline of the curve. Draw a line along the outside edge of the block, and then place the base of a protractor on this line and adjust the arm so that it aligns with the centerline. Record the angle and then bevel both



Angled sample blocks. *Use blocks with different bevel angles to determine the best angle to cut the adjacent stave. After beveling both sides of the stave at the same angle, tape it to the assembly and repeat the process.*

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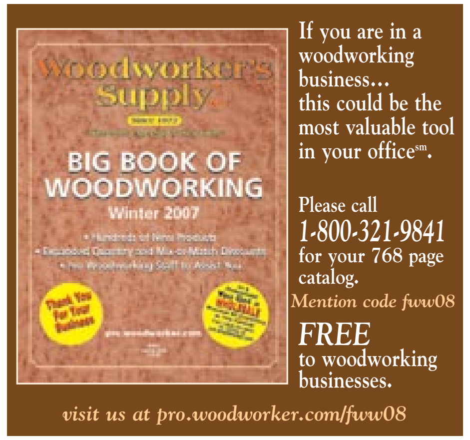

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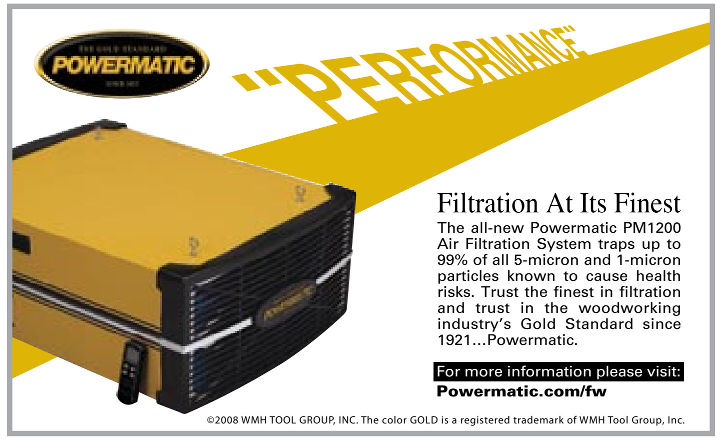

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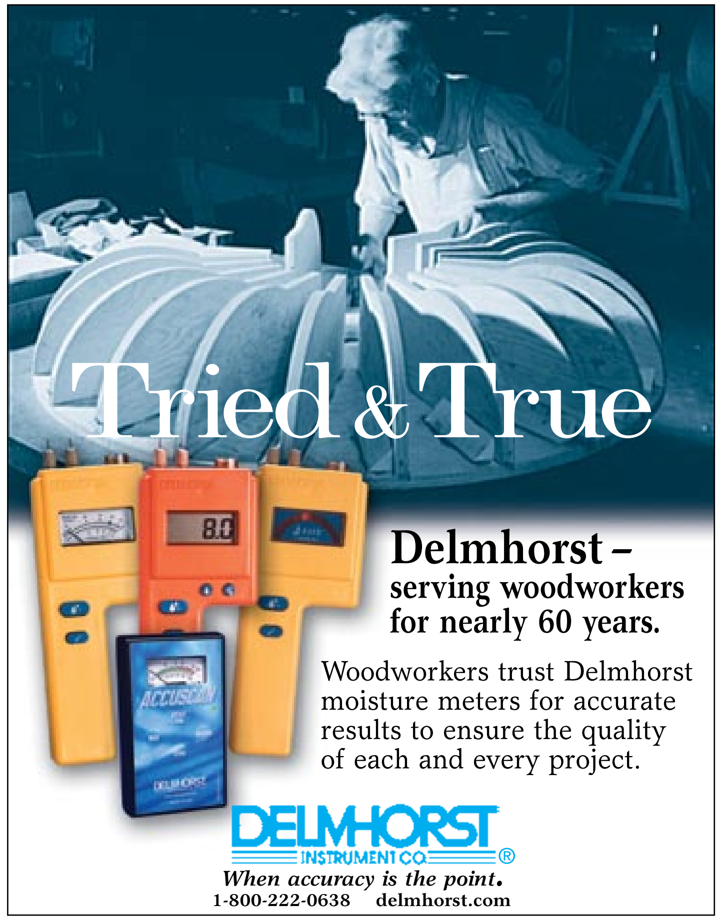

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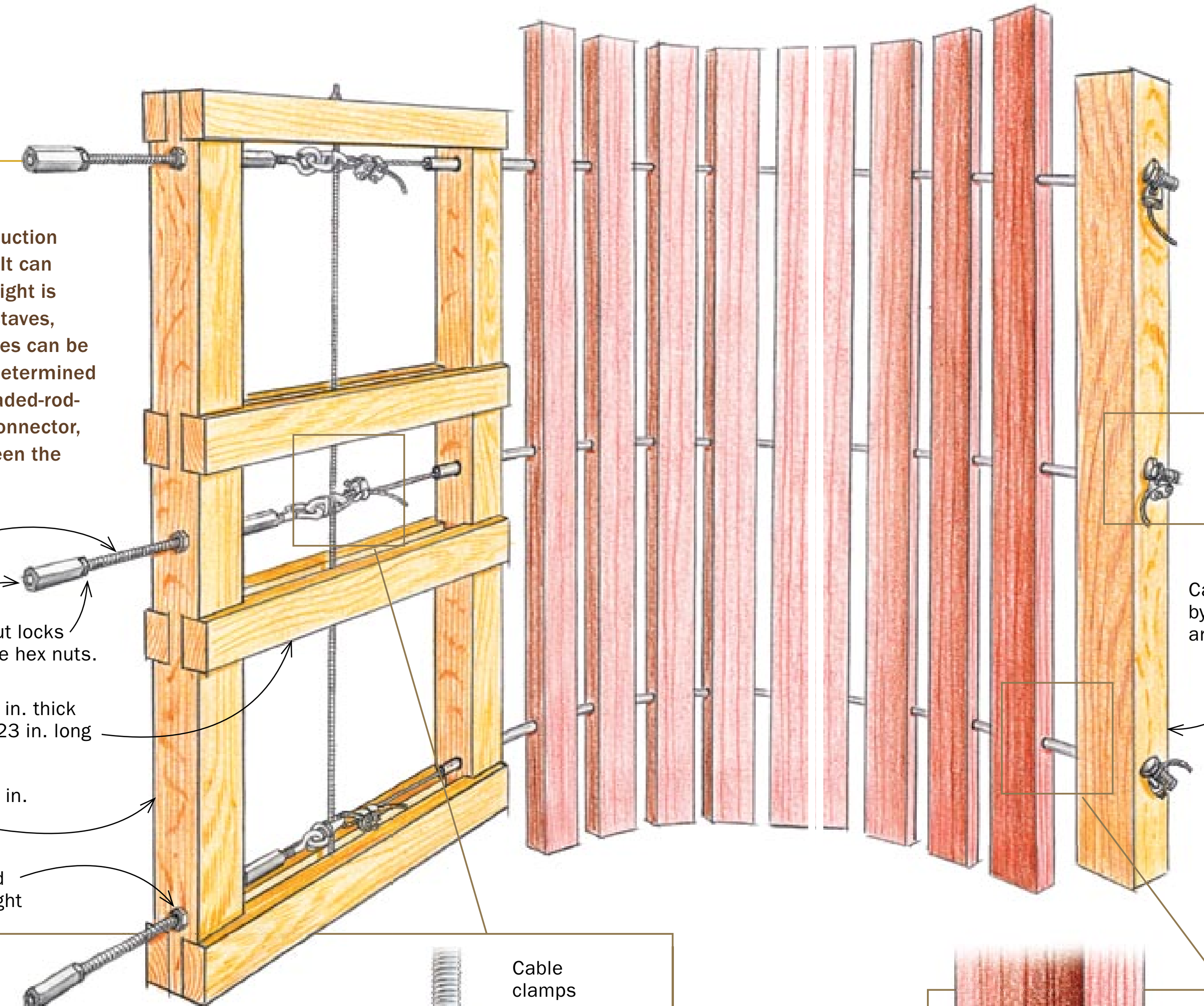
Glue up the slab

Connect the staves. *After feeding the tubing through the holes, stand the staves upright and insert a cable through each tube.*

Glue the staves and put the jig to work. *Apply the glue using a squeeze bottle and a small brush (above), opening up each pair of staves one at a time. Use a powerful electric drill equipped with a socket to turn the threaded rod (below) and gradually pull the staves together.*

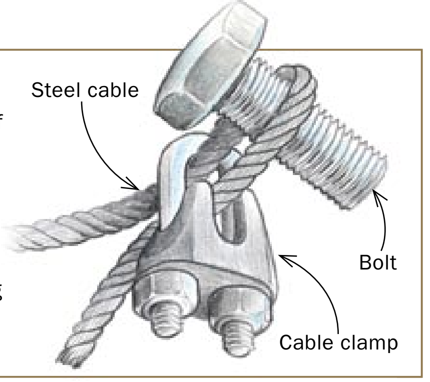
THE CABLE-CLAMPING JIG

The jig should be of strong construction using a tough wood such as oak. It can be built to any dimension. The height is determined by the length of the staves, although, as in this case, the staves can be up to a foot longer. The width is determined by the space needed for the threaded-rod-to-cable interface (hook, swivel connector, etc.) plus the room needed between the staves for applying glue.



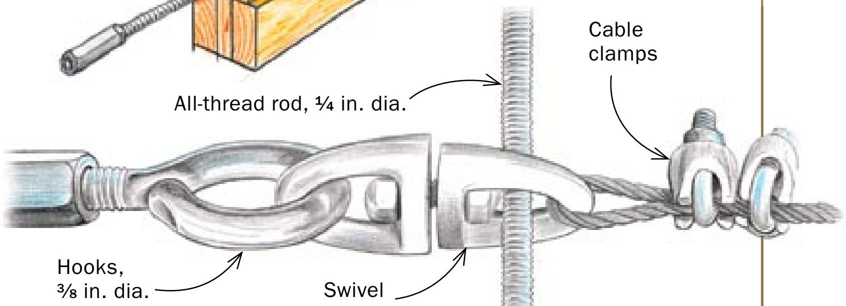
CABLE ENDS

Feed the far end of the cables through a stout caul and secure the ends using a bolt and a cable clamp. This will prevent the cable from slipping when pressure is applied.

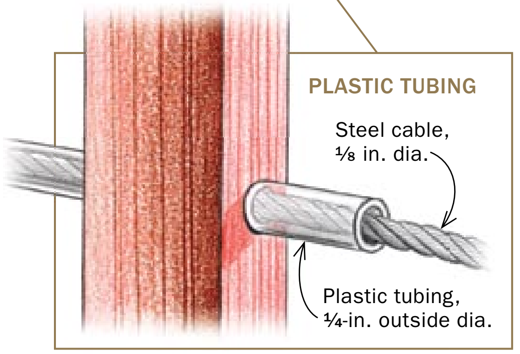


SWIVEL CONNECTORS

A vertical threaded rod goes through the sections of the three swivel connectors closest to the workpiece. This helps to stabilize one end of the swivel connectors and prevent the cable from twisting as the threaded rod is turned.



PLASTIC TUBING



sides of the two center staves at this angle. If you have a right-tilt saw like mine, you'll want to ensure that the inside of the stave is always face up. For a left-tilt saw, it should be face down.

Tape the two staves together and place them on the MDF curve. Use the sample blocks, centered between the layout lines, to find the best angle for the next stave. Bevel both sides of the stave at this angle, tape the stave to the preceding staves, and repeat the process.

After ripping the bevels on the tablesaw, give them a light pass on the jointer to ensure a clean surface and a tight fit. Once all of the staves are prepared, they can be assembled in the jig.

Test the jig with a dry run

Lay out the staves in their correct order on an assembly table and thread the polypropylene tubing through the holes. You can now stand the assembly upright adjacent to the cable jig and insert the 1⁄8-in.-dia. cable through the tubing. It's easier to wax both the tubing and the cable with paste wax. The assembly should be loose enough to apply glue to the inside edges of the staves, but snug enough that you can take up all the slack when the rods are tightened. The three cables are then threaded through and secured to a hardwood caul.

Before using the system, I do a dry run to eliminate surprises. Clamp the frame of the jig securely to the assembly table or workbench and begin to turn the all-thread rods. Using the drill to drive all three rods allows you to apply complete clamping pressure within minutes.

Assuming all seems well, reverse the drill to drive the rods back through the frame and pull the staves apart. I use urea-formaldehyde glue because of its long open time, great strength, and resistance to glue creep. Apply the glue to one joint at a time, then snug up that joint to expose the next one for gluing.

When all the joints are glued, retract the rods a bit at a time until the staves are tightly clamped, and let them sit overnight at a minimum temperature of 70°F.

Conceal the cable holes

After you have removed the cables and tubing, use a coarse sanding disk on an angle grinder to remove the squeeze-out and start rounding both surfaces. I then use a curved scraper on the inside and a sander on the outside.

You can conceal the holes in the staves a couple of different ways. You can hold back the two outside staves from each piece and glue them on after the piece is glued up. An easier solution is to fill the holes with plugs that match in color and grain. Square up the holes using a hollow-chisel bit and mallet, and then glue in the matching plugs. □

Clean up

Concave cleanup. *An angle grinder fitted with a sanding disk does the initial shaping, and a curved scraper (above) follows.*

TWO WAYS TO CONCEAL THE HOLES

Add outside staves or plug the holes. *You can reserve a pair of staves and glue them to the finished panel (above), gluing temporary clamping blocks to the workpiece. Or use a piece of matching wood to create a nearly invisible plug (left).*

Drawings: John Tetreault

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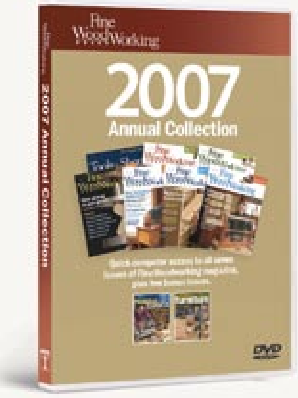

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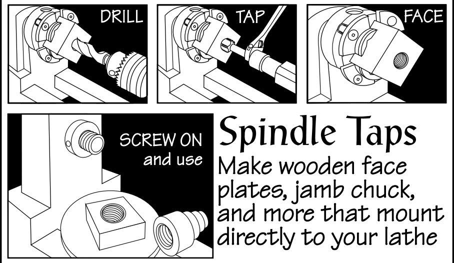

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Sample boards: No surprises

TEST YOUR FINISH BEFORE IT'S TOO LATE

BY TERI MASASCHI

A test sample shows the way. *Without this step-by-step sample board, the complex finish on the bird's-eye maple table would have been a hit-or-miss proposition, at best.*

Spend weeks making a beautiful piece of furniture, and the last thing you want is the finish to be a nasty surprise: a look that magnifies your poor sanding; one that display's the wood's blotchiness; or a stain that's simply the wrong color. That's why you should always test the finish on a sample board rather than on the project. By making all of the potential mistakes on the scrap instead of the project, life can still go on without the huge task of reworking a finishing nightmare. The only disaster is the test piece!

How to make a sample board

For the best results, use a cutoff from each of the woods used to make the project. This includes plywood, veneered panels, and solid lumber. Use a piece that's big enough to give you a good read: at least 7 in. square for each step of the finishing process.

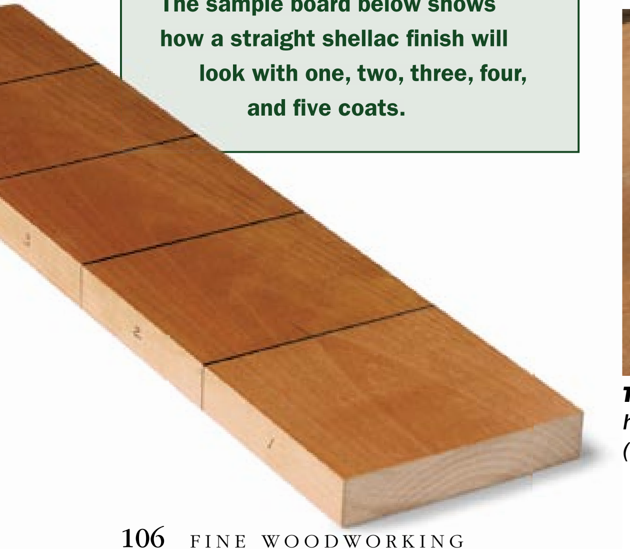
It's important to prepare the sample board's surface exactly as you will the actual workpiece. Sand or scrape it too much or not enough, and you'll get a misread on the stain and the sheen. There's a light-year's difference between a stained finish on pine at P150-grit and at P400-grit.

Testing just a clear coat—The basic sample board (below left) shows what the wood will look like with just a clear finish. Apply one coat to the whole board. Let it dry, mark off one-fifth of the board at one end, and apply a second coat to the rest of the board. Repeat the process until the last section receives a fifth coat.

This "step sample" is a graphic way to show how many coats

A clear finish

Even a clear finish needs testing. The sample board below shows how a straight shellac finish will look with one, two, three, four, and five coats.



TEST AN OIL FINISH FOR BLOTCHING

Try different methods. *The Danish oil-finished sample board (far right) shows how blotches can be overcome in either of two ways: by presanding to a higher grit (left), or by applying a washcoat before the stain (right).*

Photos: Charlie Reina

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Adding a stain

Top stain samples with a clear coat. *You need to apply several coats of clear finish to see how a stain will look.*

must be applied. On certain woods, even a clear coat can blotch, especially if it is oil-based. The sample alerts the finisher to change course by pre-conditioning, sanding to a higher grit, or changing the coating material altogether.

Adding a stain—One up from the basic sample board is one showing a stain first and then a clear coat. But continue with the clear coats up to the desired sheen, as this will give a complete indication of what the stain will be like with the finished or "wet" look.

A slightly more sophisticated sample

When the finishing plan calls for multicolor layering, it becomes imperative to use a step sample.

Like the example showing five coats of shellac on p. 106, each step is isolated on the board. On the walnut sample below, lemon-yellow dye is applied to the whole board but left uncoated in the first section. A seal coat of shellac is applied as the second step. The third panel shows the application of a glaze, and so on.

This process is necessary to visually document the raw appearance for historical reference. It's important to make notes on every detail of the process including the date; it's vital information when working with cherry and other woods that age dramatically in a short period of time.

Years from now, you'll be able to go to the sample board and make sure that any new or repair work is progressing to match the original piece perfectly.

In short, the test sample helps you achieve two key goals of finishing: predictability and repeatability. The sample predicts the wisdom (or folly) of the finishing plan, and it allows you to repeat or duplicate the chosen plan in the future.

With a test sample, finishing your project can turn a nightmare into a dream. □

Making a multicolor sample

A step sample can document a complex coloring process. Start by prepping the sample board and then apply each layer of finish.

From prep to finish. *Start by scraping, planing, or sanding the sample board as you will the actual workpiece (left). Then mark the lines separating each step in the coloring process (center). Then apply the finish, coat by coat, until the desired color and gloss are achieved (right). A piece of blue tape offers a way to isolate a section.*

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how they did it

Out of the past and into the present

BY ANISSA KAPSALES

1. Start at the source
Williams gathered information from books, photographs, and the original piece.

Reproducing museum furniture isn't easy, but a combination of tricks can bring you extremely close to the original. According to Jeff Williams of Irion Company Furniture Makers, who made the library bookcase featured on the back cover, the best-case scenario is to have the original in your shop as you are making the copy. He couldn't do that, but he did the next best thing. Williams began with photos and documentation from a book, then visited the original in the Heyward-Washington House in Charleston, S.C.

The Furniture of Charleston 1680-1820, Volume I: Colonial Furniture by Bradford L. Rauschenberg and John Bivins Jr. was a tremendous resource for Williams. From it he got dimensions, a list of materials, construction methods (including photos of joinery), and details of the pediment, marquetry, and inlay, which he enlarged on a photocopier to use as patterns. Most importantly, he was able to familiarize himself with the overall piece, making his visit to the original as productive as it could be.

The rare, full access he had to the original was also invaluable. He got detailed measurements, tracings of shapes, and photographs not shown in the book. When he returned to his shop, Williams began converting all this information into full-size plans before cutting a single piece of wood.

For more on the Irion Company's nine-year commission and the 90-plus reproductions it has entailed so far, see pp. 78-83.

2. Make a full-size plan
Before compiling an extensive materials/cutlist (left), Williams turned the information he'd gathered into a full-size story board for the height of the piece (without the pediment) and its vertical landmark points. He then made a full-size drawing of half the width and full depth, marking all the vital measurements and connecting the dots (above).

3. Add the details

Creating the pediment. *Williams projected a slide through a glass panel, adjusting the distance to get to full size. Drawing on paper taped to the far side kept his body from blocking the projection as he traced.*

Sizing the marquetry. *He used a circular proportional scale to calculate how much to enlarge an image on a photocopier, checking the size against the drawing of the pediment.*

Making templates. *Williams transformed his measurements and tracings into rigid templates for the 10 different curves on the drawers, pediment, doors, feet, and plinth.*

Photos: Staff

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Scaling the Heights

Jeff Williams, who started out sweeping floors at Irion Company Furniture Makers 20 years ago, built every part of this Holmes-Edwards library bookcase reproduction except the carved flowers at the top. It is typical at Irion, a 60-year-old Pennsylvania shop that specializes in reproducing American antiques, for a single craftsman to take a project from initial drawings to completion. But not much else was typical about this piece. At 100 in. wide and almost 11 ft. tall, the Holmes-Edwards, built around 1770 in Charleston, S.C., is overwhelming—even to a veteran craftsman like Williams. When he caught his first glimpse of the original, Williams says, "A mosquito could have knocked me over."

He spent a year and a quarter building the piece, logging 2,400 hours. Yet in all that time, he never saw the piece fully assembled—the Irion shop's 10-ft. ceilings were too low to allow it. Not until the French polish was done did Williams and his co-workers carry the upper and lower cases and the cornice outside and fit them together for the first time.

Most surprising of all, this majestic piece is just one part of a far larger project—a landmark commission to furnish a huge house entirely with reproductions of American masterpieces. Over the last eight years, Irion has delivered some 90 pieces to the house, including two other library bookcases. For a look at the rest of this project, see the complete article on p. 78.

—Jonathan Binzen

Photo: Kendl Monn

How They Did It Turn to p. 110 to learn how Williams copied the original; for the complete story on this commission, go to p. 78.

Pro Portfolio For a narrated slide show that takes you behind the scenes at the Irion Company, go to FineWoodworking.com/extras.